Acerca de este libro

Esta es una copia digital de un libro que, durante generaciones, se ha conservado en las estanterías de una biblioteca, hasta que Google ha decidido escanearlo como parte de un proyecto que pretende que sea posible descubrir en línea libros de todo el mundo.

Ha sobrevivido tantos años como para que los derechos de autor hayan expirado y el libro pase a ser de dominio público. El que un libro sea de dominio público significa que nunca ha estado protegido por derechos de autor, o bien que el período legal de estos derechos ya ha expirado. Es posible que una misma obra sea de dominio público en unos países y, sin embargo, no lo sea en otros. Los libros de dominio público son nuestras puertas hacia el pasado, suponen un patrimonio histórico, cultural y de conocimientos que, a menudo, resulta difícil de descubrir.

Todas las anotaciones, marcas y otras señales en los márgenes que estén presentes en el volumen original aparecerán también en este archivo como testimonio del largo viaje que el libro ha recorrido desde el editor hasta la biblioteca y, finalmente, hasta usted.

Normas de uso

Google se enorgullece de poder colaborar con distintas bibliotecas para digitalizar los materiales de dominio público a fin de hacerlos accesibles a todo el mundo. Los libros de dominio público son patrimonio de todos, nosotros somos sus humildes guardianes. No obstante, se trata de un trabajo caro. Por este motivo, y para poder ofrecer este recurso, hemos tomado medidas para evitar que se produzca un abuso por parte de terceros con fines comerciales, y hemos incluido restricciones técnicas sobre las solicitudes automatizadas.

Asimismo, le pedimos que:

+ *Haga un uso exclusivamente no comercial de estos archivos* Hemos diseñado la Búsqueda de libros de Google para el uso de particulares; como tal, le pedimos que utilice estos archivos con fines personales, y no comerciales.
+ *No envíe solicitudes automatizadas* Por favor, no envíe solicitudes automatizadas de ningún tipo al sistema de Google. Si está llevando a cabo una investigación sobre traducción automática, reconocimiento óptico de caracteres u otros campos para los que resulte útil disfrutar de acceso a una gran cantidad de texto, por favor, envíenos un mensaje. Fomentamos el uso de materiales de dominio público con estos propósitos y seguro que podremos ayudarle.
+ *Conserve la atribución* La filigrana de Google que verá en todos los archivos es fundamental para informar a los usuarios sobre este proyecto y ayudarles a encontrar materiales adicionales en la Búsqueda de libros de Google. Por favor, no la elimine.
+ *Manténgase siempre dentro de la legalidad* Sea cual sea el uso que haga de estos materiales, recuerde que es responsable de asegurarse de que todo lo que hace es legal. No dé por sentado que, por el hecho de que una obra se considere de dominio público para los usuarios de los Estados Unidos, lo será también para los usuarios de otros países. La legislación sobre derechos de autor varía de un país a otro, y no podemos facilitar información sobre si está permitido un uso específico de algún libro. Por favor, no suponga que la aparición de un libro en nuestro programa significa que se puede utilizar de igual manera en todo el mundo. La responsabilidad ante la infracción de los derechos de autor puede ser muy grave.

Acerca de la Búsqueda de libros de Google

El objetivo de Google consiste en organizar información procedente de todo el mundo y hacerla accesible y útil de forma universal. El programa de Búsqueda de libros de Google ayuda a los lectores a descubrir los libros de todo el mundo a la vez que ayuda a autores y editores a llegar a nuevas audiencias. Podrá realizar búsquedas en el texto completo de este libro en la web, en la página `http://books.google.com`

This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google books

https://books.google.com

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

N-4

ASSOCIATION

—OF—

EDISON ILLUMINATING COMPANIES.

MINUTES OF NINTH ANNUAL MEETING,

(FOURTEENTH CONVENTION,)

HELD AT THE

WISCONSIN STATE BUILDING,

WORLD'S COLUMBIAN EXPOSITION, CHICAGO, ILL.,

AUGUST 8TH AND 9TH, 1893.

Compiled by the Secretary and Published by Order of the Association.

NEW YORK:
1893.

F. W. C. BAILEY,
38-12th AVENUE,
COLUMBUS, OHIO

Digitized by Google

TK 1
A8
1893

Digitized by Google

Office of the Secretary,
358 Pearl Street,
Brooklyn, N. Y.

To the Members of the Association.

Gentlemen:

In assuming the position of Secretary of the Association, the fourth since its organization in 1885, I have continued the general methods of compiling and publishing the Minutes which have been so faithfully worked out by my predecessors in office.

Not having enjoyed the advantage of being present in person at the Chicago Convention, I have depended upon the report secured by Mr. Jenks. The General Electric Company has kindly donated several valuable documents which have been added to the Minutes in the form of appendices.

Probably the most useful of these and those most worthy the careful perusal by every member, are the decisions of the courts in the Edison patent litigation, and these, taken in connection with similar judgments contained in the records of previous conventions, constitute an outline of judicial opinions, which must be of substantial value in the history of the art of electric lighting.

The decisions heretofore printed in the Association Records are as follows:

Judge Bradley's Decision, Fibrous Carbon Case.—Appendix A, Niagara Falls Meeting.

Second Canadian Decision, Filament Patent.—Appendix B, Niagara Falls Meeting.

Judge Wallace's Decision, Filament Patent.—Appendix C, New York Meeting.

Judge Wallace's Decree, Filament Patent.—Appendix D, New York Meeting.

374597

Digitized by Google

Decision of U. S. Circuit Court of Appeals (Second Circuit), Filament Patent.—Appendix B, Toronto Meeting.

Decision of U. S. Circuit Court of Appeals (Second Circuit), Filament Patent, Sawyer-Man Case.—Appendix C, Toronto Meeting.

Injunction Orders (Filament Patent) against various Lamp Manufacturers.—Appendix D, Toronto Meeting.

Judge Colt's Written Decision, Filament Patent.—Appendix E, Toronto Meeting.

This compilation of legal decisions brings the record of the lamp litigation up to date.

During the past year the number of reserve copies of previous Minutes has been reduced, and the Secretary will soon be unable to provide members with anything like complete files. Any member in good standing may now secure those issued, which are still obtainable, bound in three volumes, by application of the Officer of Record, enclosing $5, which covers cost of binding and mail or express charges.

Members will notice that the next meeting will be held August 14, 1894, in Boston, the precise place of holding the sessions to be later announced by the Executive Committee. This is in pursuance of the invitation from the officials of the General Electric Company, and of the President of the Association on behalf of the Edison Electric Illuminating Company of Boston. Both of these companies desire to extend on that occasion the hospitalities of the New England centre of the business to the members of the Association.

The Secretary earnestly requests the co-operation of the members of the Association in any suggestions on matters of general interest, and especially urges that each member interest himself in the offering of a paper for the next convention.

The Secretary's most earnest desire is the serving of the Association in any direction approved of by the Executive Committee, thus carrying out as fully as circumstances will permit the idea expressed by the By-Laws, that the Association has for its object "Mutual protection, and the collection and dissemination of information relative to the Edison business."

The Secretary is indebted to Mr. Allen R. Foote for his courtesy in supplying the Association with a copy of his com-

Digitized by Google

pilation on the laws of Massachusetts, relative to the Board of Gas and Electric Light Commissioners (Appendix J); to Mr. F. E. Barker for his suggestions regarding sources of information bearing upon the same subject; and to the publishers of the "Electrical World" and "Western Electrician" for the loan of several cuts used in illustrating the Minutes.

Very truly yours,

W. S. Barstow
Secretary

Digitized by Google

Digitized by Google

CONTENTS.

List of Officers, Members and Committees. ix

FIRST SESSION.

	PAGE.
President's opening address	13
List of delegates present	15
State control of electric lighting interests	17
F. E. Barker's address	18
Report of the Committee on Grounding the Neutral Wire	22
Report of the Committee on Lightning Protection	22
Relations between the Association and the General Electric Co.	38
Electrical Engineering at the World's Fair.—Paper by L. Stieringer	46
Capt. Brophy's address	55
Entertainment by General Electric Co.	67

SECOND SESSION.

The Central Station Switchboard, etc.—Paper by A. B. Herrick	68
Treasurer's Report	78
The Carrying Capacity of Electric Cables, etc.—Paper by A. E. Kennelly	79
Mr. Carpenter on Rheostats	93

THIRD SESSION.

Description and Test Third District Station, Brooklyn Co.—Paper by W. S. Barstow	99
Election of Officers	119
Sale of Lamps in Licensed Territory	122
Report of Committee on Contract or Lamp Order	133
Stealing Central Station Current	134
Report of the Executive Committee	135
Report of the Committee on Fuel Gas	136

Digitized by Google

Report of the Committee on Prevention of Damage from Crosses with High Tension Circuits 136
A Summary of the Goebel Defense 137
Courtesies Acknowledged 138
The Place of Meeting in 1894 138
Final Adjournment 139
Evening Entertainment 139

APPENDICES.

A.—Detailed description of the method pursued at Elgin, Ill., to secure protection from Lightning.

B.—Judge Acheson's Decision—Weston Carbon Treatment Case.

C.—Injunction Orders and Decrees (Filament Patent), to March 20, 1893.

D.—Judge Seaman's Decision (Filament Patent). Case against Electric Mfg. Co.

E.—Injunction Orders (Filament Patent) against The Holland House, The Imperial Hotel and William Zinsser, of New York City.

F.—Judge Ricks' Decision (Filament Patent). Case against Packard Electric Co.

G.—Judge Lacombe's Decision (Filament Patent). Case against the Mt. Morris Electric Light Co. and The United Electric Light & Power Co. of New York City.

H.—Judge Green's Decision (Feeder Patent). Case against Westinghouse, Church, Kerr & Co.

I.—Article regarding General Electric Co., reprinted from *The Forum* of February, 1893.

J.—Law creating and controlling the Massachusetts Board of Gas and Electric Light Commissioners.

K.—Decision Circuit Court of Appeals, Second Circuit (Filament Patent). Case against The Mt. Morris Electric Light Co. and The United Electric Light and Power Co.

L.—Decision Circuit Court of Appeals, Third Circuit, Weston Carbon Treatment Case.

M.—Judge Hallett's Decision (Filament Patent). Case against Columbia Incandescent Lamp Co.

N.—Judge Colt's Oral Decision (Filament Patent). Case against Beacon Vacuum Pump and Electrical Co.

O.—Decision of Deputy Commissioner of Patents Pope (Filament Patent), First Canadian Decision.

P.—Judge Colt's Decision (Filament Patent). Case against Davis Electrical Works.

Q.—English Decisions,—Filament Patent.

R.—Injunction Orders and Decrees (Filament Patent), Mar.-Dec., 1893.

S.—Reprint of an article from *The Electrical World* of Sept. 23, 1893, by John M'Ghie, entitled "The General Electric Company at the World's Fair."

T.—General Electric Co. World's Fair Folders.

Digitized by Google

OFFICERS AND COMMITTEES.
1893-1894.

OFFICERS.

President, Chas. L. Edgar, - - - Boston.
Vice-President. Geo. H. Finn, - - St. Paul.
Secretary, W. S. Barstow, - - - - Brooklyn.
Treasurer, Wilson S. Howell - - Orange, N. J.

COMMITTEES.

EXECUTIVE COMMITTEE.

John I. Beggs, *Chairman*, - - - New York City.
C. P. Gilbert, - - - - - - Detroit, Mich.
E. R. Weeks, - - - - - - Kansas City, Mo.
W. D. Marks, - - - - - - Philadelphia, Pa.
James W. Pryor, - - - - - New York City.
C. L. Edgar, *ex-officio*, - - - - Boston, Mass.

COMMITTEE ON LIGHTNING PROTECTION, PREVENTION OF DAMAGE FROM CROSSES WITH HIGH TENSION CIRCUITS, AND GROUNDING THE NEUTRAL WIRE IN THREE-WIRE SYSTEMS.

A. E. Kennelly, *Chairman*, - - - Orange, N. J.
Wilson S. Howell, - - - - - Orange, N. J.
F. E. Jackson, - - - - - East Orange, N. J.
C. P. Gilbert, - - - - - - Detroit, Mich.
W. D. Marks, - - - - - Philadelphia, Pa.
H. J. Smith, - - - - - - New York City.

COMMITTEE ON LAMP ORDER OR CONTRACT.

James P. Dickson, *Chairman*, - - Scranton, Pa.
James W. Pryor, - - - - - New York City.
E. R. Weeks, - - - - - Kansas City, Mo.

Digitized by Google

MEMBERS AT DATE OF CHICAGO MEETING.

AMSTERDAM, N. Y.,
EDISON ELECTRIC LIGHT AND POWER CO.
APPLETON, WIS.,
APPLETON EDISON ELECTRIC CO.
BOSTON, MASS.
EDISON ELECTRIC ILLUMINATING CO.
BROCKTON, MASS.,
EDISON ELECTRIC ILLUMINATING CO.
BROOKLYN, N. Y.,
EDISON ELECTRIC ILLUMINATING CO.
CHICAGO, ILL.,
CHICAGO EDISON CO.
CINCINNATI, O.,
CINCINNATI EDISON ELECTRIC CO.
COLUMBUS, O.,
COLUMBUS EDISON ELECTRIC LIGHT CO.
CUMBERLAND, MD.,
EDISON ELECTRIC ILLUMINATING CO.
DES MOINES, IOWA,
DES MOINES EDISON LIGHT CO.
DETROIT, MICH.,
EDISON ILLUMINATING CO.
EASTON, PA.,
EDISON ELECTRIC LIGHT CO.
EDISON ELECTRIC LIGHT CO. (Parent Co.)
EDISON GENERAL ELECTRIC CO. (Lamp Works).
EDISON GENERAL ELECTRIC CO. (Schenectady Works)
ELGIN, ILL.,
ELGIN CITY RAILWAY CO.
GRAND RAPIDS, MICH.,
EDISON ELECTRIC LIGHT CO.
HARRISBURG, PA.,
HARRISBURG ELECTRIC CO.
HOWELL, WILSON S., Treasurer of the Association.
KANSAS CITY, MO.,
EDISON ELECTRIC LIGHT AND POWER CO.

Digitized by Google

LITTLE ROCK, ARK.,
EDISON ELECTRIC LIGHT AND POWER CO.
LACROSSE, WIS.,
EDISON LIGHT AND POWER CO.
LARAMIE, WY.,
LARAMIE ELECTRIC, GAS LIGHT AND FUEL CO.
LAWRENCE, MASS.,
EDISON ELECTRIC ILLUMINATING CO.
LEBANON, PA.,
EDISON ELECTRIC ILLUMINATING CO.
MILAN, ITALY,
SÓCIETA GENERALE ITALIANA DI ELETTRICITA SISTEMA EDISON.
MITCHELL, S. Z.
NEW BEDFORD, MASS.,
NEW BEDFORD GAS AND EDISON LIGHT CO.
NEW ORLEANS, LA.,
EDISON ELECTRIC ILLUMINATING CO.
NEW YORK, N. Y.,
EDISON ELECTRIC ILLUMINATING CO.
PATERSON, N. J.,
EDISON ELECTRIC ILLUMINATING CO.
PHILADELPHIA, PA.,
EDISON ELECTRIC LIGHT CO.
READING, PA.,
READING ELECTRIC LIGHT AND POWER CO.
RENOVO, PA.,
RENOVO EDISON LIGHT, HEAT AND POWER CO.
ROCHESTER, N. Y.,
ROCHESTER GAS AND ELECTRIC CO.
ROCKFORD, ILL.,
FOREST CITY ELECTRIC LIGHT AND POWER CO.
SAN FRANCISCO, CAL.,
EDISON LIGHT AND POWER CO.
SCRANTON, PA.,
SCRANTON ILLUMINATING, HEAT AND POWER CO.
SPOKANE, WASHINGTON,
EDISON ILLUMINATING CO.

Digitized by Google

St. Paul, Minn.,
    Edison Electric Light and Power Co.
Tiffin, O.,
    The Tiffin Edison Electric Illuminating Co.
Topeka, Kansas,
    Edison Electric Illuminating Co.
Waterbury, Conn.,
    Connecticut Electric Co.
Waterloo, N. Y.,
    Waterloo Electric Co.
West Chester, Pa.,
    Edison Electric Illuminating Co.
Wilkes Barre, Pa.,
    Wilkes Barre Electric Light Co.
Williamsport, Pa.,
    The Edison Electric Illuminating Co.
Wilmington, Del.,
    Wilmington City Electric Co.
York, Pa.,
    Edison Electric Light Co.

Digitized by Google

REPORT

OF THE

NINTH ANNUAL MEETING

(Fourteenth Convention)

OF THE

ASSOCIATION OF

EDISON ILLUMINATING COMPANIES,

HELD AT THE

WISCONSIN STATE BUILDING, WORLD'S COLUMBIAN EXPOSITION GROUNDS,

CHICAGO, ILL.,

August 8th and 9th, 1893.

FIRST SESSION.

The Convention was called to order at 2 P. M.. Tuesday, August 8th, by the President, Mr. John I. Beggs, in the following opening address :

Gentlemen of the Association : Once more, as for eight years past, I call you to order with one special request, namely, that you continue in the sessions now before us, to show that zeal and strict attention to business, which has given rise to the only criticism which has, so far as I know, been made upon our methods at these meetings, that we have pushed business rapidly. We are met amid the stirring sights and sounds of this wonderful World's Fair. Let us make our convention our first duty while it lasts, and whether we make its sessions long or short—a few long ones or many short ones, let us show the old-time interest by coming in full numbers, and gathering promptly at the hours which may from time to time be appointed.

Each year is bringing about very great changes in the business in which we are engaged. Many of us have large interests at stake, and those in-

Digitized by Google

terests are menaced at the present time from many points, and, therefore, careful consideration should be given to the many matters before this Association. I recall seven years or more ago the convention that met in Atlantic City. There were but very few companies organized then, and there were none of the mammoth concerns which to-day seem to have relations very different from that of the mass of small companies. Thus the question arises whether the small companies will not have to ask from these larger ones some protection; not so much the protection of the parent company, as the protection of the small companies against the infringement of the large ones. I know where to-day a number of small companies are being put to great loss and to great trouble, because of the lamps that are being shipped into their territory through these large companies, to equip and maintain the operation of isolated plants that the courts have ruled cannot run except by getting Edison lamps, and they have been setting up the plea that they are not using Edison lamps. This seems to be to-day a matter of very serious moment. I am interested in one company that I consider the loser of thousands of dollars through this very thing. My impression is that these lamps come from this city. They may have crossed the Rocky Mountains to reach there, but they are being used to-day to put in installations, the claim being made that they are not Edison lamps, but they are Edison. This question is one of very great importance, and one no doubt to which, this Association will give serious consideration.

Another subject of great consequence which this Association should consider, is whether our interests will not be advanced by the organization of state associations, rather than being exclusively dependent upon one large association. Not doing away with that, or making it any less initial in the particular matters in which we are deeply interested, and which require our attention; but I think our business would be improved by the organization of state associations. In Pennsylvania steps have already been taken, and an organization has been formed there that will give its attention to these questions, not only as they pertain to state and municipal matters, but as they pertain to these small companies. In Pennsylvania a bill was gotten on foot to tax each citizen $5.00 per poll per annum. A state association would do much to correct a feeling of that kind. We had before the Pennsylvania legislature, during the past winter, a bill to make the maximum rate for incandescent and arc lighting so ridiculously low that it would have driven every owner of an electric light plant out of the business, and it took considerable influence to defeat this bill. This will give you an idea as to how matters stand in the eastern communities. Every community has an electric plant, and the people of many communities think that the owners of such plants possess perfect mines of wealth. I wish more of them were mines of this kind, but, nevertheless, like all corporations, they are deemed proper prey. State associations could do more than anything else towards the proper handling of these matters. I preside over this Association in Pennsylvania, and we have about 150 companies represented.

And, gentlemen, we are faced with conditions that did not exist a few years ago, in the fact that while many of the large companies of to-day are

Digitized by Google

influential and powerful—a condition that did not exist seven or eight years ago when this organization was formed—many of the small companies are trying to do business with the same methods with which these large companies exploit their affairs. The first thing they know they are patterning after these large companies, and getting such large ideas that their operating expenses reach such a figure that they necessarily fail to make a success of the business.

The question that seems the most important to me, is that many of the companies to-day have diversified interests. They have ceased to be purely Edison companies, and many are ceasing to do business because of lack of financial means, and are being absorbed by the larger companies.

I have had the honor of being elected President of this Association for eight consecutive years. I come here to-day to lay down that honor, and I wish to thank you now for the continued confidence you have shown, and for the continued patience and indulgence toward me during all my occupancy of this chair. I can only assure you of my most earnest interest in the welfare of the Association, which I have had at heart in the past, and which in every way I have endeavored to foster regardless of my own personal interests. And, as I resign this office, and take the place which I have often wished to occupy upon the floor of the Convention, I expect to continue to do everything in my power to advance the interests of the great body of illuminating companies.

The roll call (and additional names subsequently handed in as the members appeared upon the floor) showed that the following delegates were present:

General Electric Company.

S. DANA GREENE, *Assistant General Manager.*
F. P. FISH, *General Counsel.*
CHARLES D. DAVIS, *Assistant Manager, Lighting Department.*
E. J. SPENCER, *Special Agent in charge of Exhibits, World's Fair.*

Edison Electric Light Co.

W. J. JENKS, *Legal Department.*

Edison General Electric Company.

A. E. KENNELLY, *Consulting Electrician, Edison Laboratory.*
A. D. PAGE, *Lamp Department.*

Digitized by Google

JOHN W. HOWELL, *Lamp Department.*
WILSON S. HOWELL, " "
F. E. JACKSON, " "
ALBERT B. HERRICK, *Electrician, Schenectady Works.*

Illuminating Companies.

EDISON ELECTRIC ILLUMINATING COMPANY, NEW YORK CITY.
JAMES W. PRYOR, *Secretary.*
HARRISBURG (Pa.) ELECTRIC COMPANY, HARRISBURG, PA.
JOHN I. BEGGS, *Stockholder.*
RENOVO EDISON LIGHT, HEAT & POWER CO., RENOVO, PA.
J. H. SHEDDY, *General Manager.*
EDISON ELECTRIC LIGHT & POWER CO., LITTLE ROCK, ARK.
G. H. VAN ETTEN, *President.*
J. A. VAN ETTEN, *Manager.*
LEIGH CARROLL, *Stockholder.*
EDISON ILLUMINATING COMPANY, DETROIT, MICH.
C. P. GILBERT, *Secretary and Manager.*
HOYT POST, *Director and Attorney.*
EDISON ELECTRIC ILLUMINATING CO. OF BOSTON, MASS.
C. L. EDGAR, *General Manager.*
J. OTIS WARDWELL, *Counsel and Clerk.*
L. STIERINGER, *Stockholder.*
EDISON LIGHT COMPANY, GRAND RAPIDS, MICH.
A. F. WALKER, *Superintendent.*
DANIEL MCCOY, *President.*
APPLETON EDISON ELECTRIC CO., APPLETON, WIS.
A. L. SMITH, *President.*
SCRANTON ILLUMINATING, HEAT & POWER CO., SCRANTON, PA.
JAS. P. DICKSON, *Vice-President.*
FRED C. HAND, *Secretary.*
J. E. PARRISH, *Superintendent.*
EDISON ELECTRIC LIGHT & POWER CO., ST. PAUL, MINN.
GEO. H. FINN, *Secretary, Treasurer and Manager.*

Digitized by Google

FOREST CITY ELECTRIC LIGHT & POWER COMPANY, ROCKFORD, ILL.

M. A. BEAL, *Secretary, Treasurer and Director.*

ELGIN CITY RAILWAY CO., ELGIN, ILL.

CHR. WUESTENFELD, *Manager.*

EDISON ELECTRIC CO. OF NEW ORLEANS, LA.

E. L. BEMISS, *General Manager.*

COLUMBUS LIGHT & POWER CO., COLUMBUS, O.

C. H. LINDENBERG, *Director.*

A. W. FIELD, *Secretary and Manager.*

EDISON ELECTRIC LIGHT & POWER CO. OF KANSAS CITY, MO.

E. R. WEEKS, *General Manager.*

DES MOINES EDISON LIGHT CO. OF DES MOINES, IOWA.

J. A. COLBY, *General Manager.*

NEW BEDFORD GAS & EDISON LIGHT CO., NEW BEDFORD, MASS.

GEO. R. STETSON, *President and General Manager.*

ROCHESTER GAS & ELECTRIC CO., ROCHESTER, N. Y.

GEO. A. REDMAN, *General Supt., Electrical Dept.*

State Control of Electric Lighting Interests.

THE PRESIDENT: There are two or three gentlemen who are connected in special ways with electrical interests that we may ask the consent of the association to admit at certain times during the session. One of these gentlemen is Mr. F. E. Barker, Chairman of the Board of Gas and Electric Light Commissioners of Massachusetts, who has been a member of the commission since its inception. I think the Association should give him an opportunity to participate in some of our discussions, and it would be well if we could have an address from him, as I think the Massachusetts people took the initial step, and have done more than any other state towards putting gas and electric lighting under state direction. Mr. Barker has probably taken more interest in the electric light business of Massachusetts than any other state official, and we are in a position to profit by an address from this gentleman giving us the result of his experience. Likewise I am sure the Association would be pleased to hear from Capt. Brophy on Fire Insurance matters from an electrical standpoint, and as to the cost of maintaining mutual fire insurance organizations, and also from Mr. Carpenter on the subject of rheostats.

In welcoming Messrs. Brophy, Barker and Carpenter to the

Digitized by Google

meeting, in accordance with a vote of the Association, the Chair expressed pleasure at having them present, and hoped they would be able to impart some information to the Association.

Mr. Barker's Address.

THE PRESIDENT : We have with us Mr. F. E. Barker, of the Board of Gas and Electric Light Commissioners of the State of Massachusetts, who will have something to say to us on the matter of state and municipal organizations.

MR. BARKER : I did not suppose that I would be asked to take any of your time, and, at this brief notice, I am hardly prepared to speak very definitely or at much length. I am very glad, indeed, to be present at one of the meetings of this Association. I have heard very much about it, and have had the pleasure of a personal acquaintance with many of your members for a considerable time, so that I consider it a piece of good fortune that I am able to be present to-day.

The work of our Board is one with which some of your members are already quite familiar. It is designed, I suppose, to secure to the public and to the companies, many mutual advantages.

The jurisdiction of the Board is an unusual one. It has extraordinary powers. These may be divided into three principal heads :

1. The power to determine whether or not two companies shall exercise the privilege of supplying electric light within the same territory.

2. The power to fix rates for the supply of the company's product.

3. The power to compel the supplying of electric light upon application.

These are the three general powers of the commission, and they can be exercised only under certain conditions. For instance, the fixing of rates can only be made upon application of a certain number of consumers, or by the local authorities. Incidental to the exercise of those powers, and designed to assist in their administration is the power to compel returns with respect to the affairs of the company—its financial and technical affairs. This power is absolutely necessary for the safe, proper and conservative exercise of the others, because it supplies the Board with the necessary information, or a portion of it. It has been the policy of the Board to seek further information, with respect to the business by travel, and observation of the same, as it is carried on in other states and by an extended acquaintance with people who are engaged in the business, so that the Board may enjoy their confidence and understand their views. This, in a general way, has been the work of the Board for the years during which it has had this important jurisdiction. It was originally organized with this jurisdiction extending only over the gas companies of the state. The original scheme was started with the gas companies in the State of Massachusetts—the electric light interests saw the advantages which the Board had brought to

Digitized by Google

the gas companies after it had been in operation for three years, and the state assumed the same jurisdiction with reference to them.

The various powers of the board constitute, as you will see, a fair exchange. The local authorities surrender to the Board the right to say whether or not a second company shall exist in the same territory, and the companies, expecting to receive through the jurisdiction of the Board a monopoly in their territory, surrender in turn the right to make rates and to refuse to supply. This is perhaps, in a general way, upon such a brief notice, all I shall be able to present at this time. I will say that I have been aided very greatly in our work through the kindness of many of the engineers and managers connected with the electrical business, who have given us information and allowed us a confidence, which, I am glad to say, I believe has never been betrayed The Board keeps fully posted on the methods under which the business is transacted in States outside of Massachusetts, and it is only by such assistance as we have received that we have been able to deal as fairly by the companies and the consumers as the history of the Board shows.

I thank you, Mr. President and gentlemen, for your attention, and the privilege of attending your session.

MR. FISH : I should like to make a suggestion,that is, that the members of this Association might profit by the study of the laws of the State of Massachusetts with reference to gas and electric light. If we were to succeed in having them adopted in the different States, it would be an advantage to the public. Those provisions, in addition to the good laws which the State of Massachusetts has always had, make the situation as nearly satisfactory as it could be, and I would suggest that you, gentlemen, individually, not as a body, carefully consider the laws of Massachusetts concerning these matters.

THE PRESIDENT : I desire to thank, on behalf of the Association, Mr. Barker for his remarks, and to say that I have read with interest the reports of this commission. I look for it annually with almost as much interest as I do that of this Association. I gather from it many important statistics. I have read a great many of these reports, and I heartily endorse what Mr. Barker says in regard to controlling these interests in the State of Massachusetts, and I think it would be a good plan, as far as it is possible, for us in the different States to adopt some such method, for it would give business a much better security for an investment.

MR. WEEKS : I want to say that I, too, have watched with considerable closeness the work of the commission of which Mr. Barker is a member. I think that, along this line, as suggested by Mr. Fish and the chair, should be considered the matter of forming State associations. The work of the State associations, if such are formed, must be in a sense missionary, for the reason that, in very few States would there be enough of the Edison licensees to form an association, the members of which would profit so greatly by coming together, as has been the case with the members of this Association. In our own State, for instance, there are very few Edison companies, but in every State in the Union there are many local companies

Digitized by Google

not entirely Edison who could co-operate with the licensees, as suggested by the remarks of the chair. These could also greatly profit by following out the lines suggested by Mr. Barker's paper and by his presence here today. I look for the report of the commission with fully as much interest as I do for the reports of this convention, and I want to say, without being censorious, that I receive them more promptly.

THE PRESIDENT: I would like to supplement the idea, as thrown out by me in my previous remarks. I did not contemplate an association of the Edison licensees in the different States for mutual protection. There has got to be, all over the country, a misconception with reference to the electric light business, and there are various interests fostering this and pushing it forward. If municipalities had their own lighting plants, and if an association was formed of the electric light companies, regardless of system and regardless of affiliation in the various States, it would enable them to deal with matters of legislation as they come up, and to give such information to legislative bodies as would enable them to act intelligently. This should not be an association of Edison licensees only, but of as many lighting companies as could be gotten together. In Pennsylvania we have banded together the nucleus of an association, having secured at least one hundred and fifty companies within a year. Our membership dues are $50. This Association was formed because of the vicious legislation which was proposed there last winter, when a number of persons were compelled to get together to defeat the legislation, which would have almost ruined the electric light business in Pennsylvania, and this was organized with the idea that we gradually educate the State up to forming a commission, having powers similar to the one in Massachusetts.

MR. EDGAR: I want to say that there has been, in Massachusetts, for some time an association exactly of that kind. There is over $10,000,000 represented in the association in the way of capital, and we have regular paid officers and a permanent organization. Thousands of circulars have been scattered broadcast over the State, and a regular association has been kept up for three or four years.

THE PRESIDENT: One of the things we found in Pennsylvania (I state this particularly because of the interest taken in it there at the time) was that, in the city of Alleghany, which was running its own municipal plant, it was claimed that this was being run without cost to the city. There is where the stories and reports of exorbitant charges on the part of illuminating companies arose. The local companies in Pittsburg, together with others, apprehending the state of affairs, took occasion to put an expert on the books in the City Auditor's office for a period covering two years, and from all the figures that were paid out on that plant, it was shown that it was costing at the rate of over $130 per lamp per annum to supply the lights —a rate greatly in excess of what companies there would have been glad to have furnished them for. It was found that many of the expenses belonging to the electric plant were charged, by parties interested in suppressing the figures, to other public branches.

MR. BROPHY: I will say that, during the meeting of our legislature, the

Digitized by Google

most vicious attack was made on electric light companies. Some of our would-be governors have led this attack, and had it not been for the existence of this association, the money invested in electric lighting property would have been worthless in case the Governor had not had the good-sense to veto the bill, which I doubt very much if he would. Perhaps I have pictured these gentlemen in preparing a paper for your information and discussion:

"I need not detail to you, gentlemen, the necessary steps to pursue to organize an Electric Light Company, and the serious difficulties that often present themselves to those who attempt to secure the necessary capital for such enterprises, to say nothing of the task of paying a satisfactory dividend on the investment when secured I am quite well aware that certain honorable legislators have labored long and hard to enable towns and cities to enter into the business of municipal lighting and thus relieve themselves of the unjust tax they would have people believe is being levied on them, necessary to pay the enormous (?) dividends they claim you receive, many of them knowing that a fraction of the same would be very acceptable to most of you.

"But while honorable Mayors will descend to the level of raising false issues of this kind to enable them to reach the goal of their political ambition; while members of the great and general court will pass acts and resolve to enable cities and towns to provide nurseries, misnamed electric lighting plants, in which to spawn the followers of cheap ward politicians, and, at the same time, provide a bottomless pit into which a large share of the town and municipal taxes can be thrown without exciting the suspicions of the dear people who pay them, so long will you be held up as bloated capitalists and oppressors of the masses."

Until you organize, as we have done in the State of Massachusetts, you are not safe.

MR. BARKER: What I said in reference to the Board was very brief. I should be very glad indeed to talk with any of the gentlemen present, and, in view of the flattering notices that have been given of the report, if any members of the Association are interested, I shall be glad to send them a copy if they will give me their address.

THE PRESIDENT: I think it would be very profitable for every member to take that report and consider it carefully.

On motion of Mr. Weeks, the Secretary was instructed to prepare and incorporate in the minutes, a resumé of the laws of Massachusetts creating the Board of Gas and Electric Light Commissioners and a statement of the work accomplished by them.*

MR. EDGAR: In Massachusetts we feel proud of our position legally, and think many states could pattern after us in this respect to great advantage.

* See Appendix J.—SECRETARY.

Digitized by Google

Report of the Committee on Grounding the Neutral Wire in Three Wire Systems.

MR. KENNELLY: The report I have the honor to submit covers the opinions of all the gentlemen except that of the Chicago Edison Company, whom we trust will concur with the report as it stands.

Report.

It is the opinion of this committee that the report submitted at the New York Convention of 1891 calls for no modification.

It may be interesting to state that the Brooklyn Third District reports a continuous insulation during a period of six months of about thirty thousand ohms on the system, including house wiring at light load. This district has about fourteen miles of underground tubes, 3,000 connected incandescent lamps, and 600 arc lamps. Nevertheless, in consideration of safety from fire risks in buildings, the Manager, Mr. Barstow, reports that if grounding the neutral were left optional with him, he would prefer to have the neutral of that system grounded permanently in the station.

Evidence has also been elicited from the enquiries of the Committee on Lightning Protection, appointed by the Association, that in Edison systems of overhead conductors, grounding the neutral affords protection against damage from lightning.

It may also be mentioned that in the case of the damage incurred by the Edison system at New Orleans in December, 1891, owing to a cross with the Westinghouse high tension system, causing a number of arcs and some fire damage by leakage to ground in Edison house wirings, it is reasonable to suppose that this damage could not have occurred if the neutral wire had been permanently grounded over the Edison system.

A. E. KENNELLY, Chairman,
WILSON S. HOWELL,
C. L. EDGAR,
W. S. BARSTOW,
W. D. MARKS,
H. J. SMITH,
W. L. CHURCH.

On motion of Mr. Post the report of the Committee on the Grounding of the Neutral Wire was accepted and ordered embodied in the Minutes.

Report of the Committee on Lightning Protection.

MR. KENNELLY: The report of this committee is based upon the experience of different Electric Illuminating Companies, as indicated by the replies to a circular which the committee sent out. Aside from this there is nothing of special interest, further than that the reports from six stations for the year 1892 are exceptional for the severity of thunder storms, all of these being isolated stations.

Digitized by Google

Report.

1. Duties.—Your committee has endeavored to collect and draw up information concerning the damage that has been sustained during the past year by Edison, and also incidentally by other electric light systems, concerning the methods of protection in use, and their effectiveness; and from this information to bring forward the conclusions that may be attained.

2. Letters of Enquiry.—In order to elicit the desired information, a circular letter containing nine enquiries was forwarded in January last to all the 54 Companies in the Association, and copies were also addressed in March to 98 Illuminating Companies and individuals not in the Association, but operating for the most part Edison machinery. To these letters 68 replies were received, 30 from Association Companies, and 38 from Non-Association Companies.

In addition to the above, copies were addressed to Canadian Companies in April, through Mr. Fredk. Nicholls, of Toronto, who kindly undertook this task, and by these 11 replies from Canada have been received, bringing the total to 79.

Postal cards were addressed in May to all the Stations from whom replies had not up to that time been received calling attention to the fact.

The reports received from the different Stations are not reproduced here in detail, but the original reports will be left on file with the Secretary, who will show them to any who may wish to examine them.

3. Geographical Distribution.—The distribution of localities from which replies have been received is as follows:

UNITED STATES.

Maine	1	Skowhegan.
Vermont	1	Rutland.
Massachusetts	3	New Bedford, Lawrence, Brockton.
Rhode Island	1	Newport.
New York	6	New York City, Newburgh, Troy, Baldwinsville, Flushing, Rochester.
New Jersey	5	Rahway, New Brunswick, Atlantic City, Paterson, Trenton.
Pennsylvania	16	Chester, York, Williamsport, West Chester, Hazleton, Scranton, Renovo, Wilkesbarre, Shamokin, Bellefonte, Sunbury, Pottsville, Wayne, Tamaqua, Lancaster, Philadelphia.
Delaware	2	Wilmington, Milford.
North Carolina	1	Asheville.
Mississippi	1	Meridian.
Ohio	7	Tiffin, Columbus, Cincinnati (2), Canton, Dayton, Middletown.
Michigan	4	Jackson, Sault-Ste-Marie, Allegan, Grand Rapids.
Wisconsin	2	La Crosse, Baraboo.

Digitized by Google

Illinois	4	Peru, Rockford, Elgin, Chicago.
Iowa	1	Des Moines.
Missouri	1	Kansas City.
Louisiana	1	New Orleans.
Texas	1	Palestine.
Kansas	1	Leavenworth.
Nebraska	1	Kearney.
South Dakota	1	Sioux Falls.
Colorado	1	Denver.
Wyoming	1	Evanston.
California	2	Fresno, San Francisco.
Oregon	1	Pendleton.
Washington	2	Seattle, Spokane.
	68	

CANADA.

Ontario	3	Toronto, Hamilton, Niagara Falls.
Quebec	2	Montreal, Sherbrooke.
Manitoba	1	Winnipeg.
British Columbia	5	Nanaimo, Port Hope, Vancouver, New Westminster, Owen Sound.
Total	79	

4. *Distribution of Damage due to Lightning.*—Of these 79 stations, 13 have never had any trouble from lightning, viz.:

New York,
Philadelphia,
Chicago,
Toronto,
Cincinnati,
New Westminster, B. C.,
Vancouver, B. C.,
Seattle, Wash,
Pendleton, Ore.,
Evanston, Wyo.,
San Francisco, Cal.,
Fresno City, Cal.,
New Orleans, La.

The first four owe their immunity to the fact that their conductors are all underground. Chicago, however, reports that on one occasion, lightning entered the station by way of the smoke stack, and fused two safety strips on the + and — conductors of a feeder.

New Orleans is presumed to be protected by the overhead wires that are suspended over the Edison wires all through the city.

The remaining seven stations, with the exception of Cincinnati, are

Digitized by Google

situated in a region that appears to be practically free from thunder storms.

28 stations reported that they had had no damage during the last season.

24 stations during the past season have suffered only trivial damage, such as the melting of safety catches in fixtures, &c.

The following seven stations have had appreciable, but not serious, damage done :

New Bedford, Mass.......... Transformers (refers to lighting system only.)
Des Moines, Ia...............One armature slightly injured.
Trenton, N. J................Coils in arc lamps and transformers.
Palestine, Tex...............One indicator.
Winnipeg, Man..............One or two transformers.
Port Hope, B. C..............2 arresters burned out.
Rahway, N. J................One indicator.

The following stations have incurred serious damage during the past season :

Wilmington, Del ....15 Transformers and 1 A. C. generator.
Paterson, N. J...............4 100-KW. R. R. armatures.
Rockford, Ill.................1 armature (inc. generator.)
Elgin, Ill....... ....8 R. R. motor fields.
West Chester, Pa............2 60-KW R. R. armatures.
Montreal.....................1 R. R. 200-KW. generator, 1 A. C. generator armature, 1 arc lamp armature, several transformers.
Lancaster, Pa...............1 30-KW. Edison inc. armature, and 1 40 l. U. S. arc armature.
New Bedford...............1 500 volt power motor on R. R. cct.

Half the stations heard from have, therefore, been affected by lightning during the past season. Of these 30% had only trifling damage, 10% appreciable, and 10% serious; but if those stations are abstracted, whose locality or underground system keeps them out of danger, then damage is reported from 56%, 33% being in safety catches, 11% of distinct amount, and 12% serious.

As regards the system that sustained injury, the railroad systems have suffered most heavily :

1 200-KW. generator armatures.
4 100-KW. generator armatures.
3 60-K.W generator armatures.
8 R. R. motor fields.

Next the arc and incandescent systems in these returns have about equally shared the damage :

3 arc armatures.
2 30-KW. Edison generator armatures.
2 A. C. generator armatures, and, perhaps, 30 transformers.
1 500 Volt power motor armature.

Digitized by Google

5. *Unprotected Stations with Overhead Conductors.*—Thirteen stations report that they have not employed any arresters [other than barbed-wire or grounded conductors :]

Allegan,
Scranton,
Shamokin,
Bellefonte,
Renovo,
Baldwinsville,
Milford.
Newport, R. I..
Cincinnati (2nd District),
New Orleans,
Spokane,
Nanaimo,
New Westminster,

Of these the last five do not fear damage for reasons already mentioned.

The first four have had no trouble during the past year, and the remaining three have incurred only trivial damage.

Allegan has had about two storms a week in a locality much visited by lightning, and a town of 3,000 inhabitants, with an incandescent area of 4 square miles, and 50 inc. street lamps. The safety of the system is attributed to a barbed galvanized iron wire suspended above the conductors, and grounded at every second pole.

Scranton has been visited by severe storms. Its system is about one mile in radius. Other systems in the town have suffered from lightning, and the protection of the Edison system is supposed to be due, as in New Orleans, to the telephone wires running through the streets on the same poles. Occasionally, however, lamps have been extinguished, and fuses melted in dwelling-houses during thunder storms, so that arrestors are this year installed.

Shamokin has had frequent and severe storms. It has one square mile of area and two miles of pole line. The neutral wire is grounded in the station.

Bellefonte, Pa., had about twelve storms during the past season, some, very severe. Its system has about three miles of bare wire on poles. The incandescent system has no arresters, but the arc system is fitted with arresters. There is no barb-wire guard, and the neutral is not grounded. Twice in nine years an armature has been injured by lightning.

Renovo, Pa., has neither frequent nor severe storms. The length of wire in its system is about one mile. There is a barb-wire overhead.

Baldwinsville, N. Y., has frequent and severe storms, and about nine miles of pole line with incandescent street lamps. There is a grounded barbed-wire suspended above conductors.

Milford, Del., has not more than one storm a fortnight in summer, an area of one and a quarter miles square, and five miles of pole line. Its immunity is claimed to be due to the grounding of the neutral wire.

Digitized by Google

Newport, R. I., has six or seven storms in a season. One M. 1,200 arc armature has been weakened by repeated attacks of lightning and finally burned out.

All the stations from which appreciable or serious damage is reported appear to have been equipped with some one or more forms of lightning arrester.

6. *Forms of Lightning Arrester.*

The arresters mentioned in the returns as being employed are :

1. The old Edison resistance box type,
2. The common saw tooth arrester,
3. The Schuyler,
4. The swinging ball,
5. The Edison carbon point, magnetic break arrester,
6. The Edison condenser tube,
7. The Wason,
8. The Wirt,
9. The Wurts,
10. The Westinghouse airchamber,
11. The T. H. magnetic blow-out arrester.

1. The Edison resistance box type with plugs : This type was reported to be in use at Williamsport, Pa.; Hazelton, Pa.; Atlantic City, N. J.; Jackson, Mich.; Tamaqua, Pa.:

At Williamsport this form of arrester is in use on the incandescent circuit, and has operated. No complaints or damage reported.

At Hazelton this arrester has been employed on the incandescent circuit. It is stated to be unserviceable. The system is one mile square, and no serious damage has yet occurred.

At Atlantic City it has been in use and has operated. No serious damage has been reported.

At Jackson, Mich., it has been in use, and no trouble is reported.

At Tamaqua it is in use and no damage is reported. It is considered, however, to be of little value.

2. The Saw-Tooth arrester :

Reported in use at Des Moines, Sioux Falls, Pottsville, 1st Cincinnati, Flushing, Cincinnati, Ohio ; Sunbury and Peru.

At Des Moines it is described as being in use in the station, one on each bus bar, and to have hitherto answered all requirements, no other being installed.

At Sioux Falls this is the only arrester used, excepting guard wire, with no trouble during five and a half years ; a barbed guard wire runs above conductors over their entire length.

At Pottsville this is the only protector used. The system covers twelve city blocks. There are no complaints concerning its behavior, and there has been no trouble from lightning.

Digitized by Google

At Cincinnati, O. (1st Edison Co.), the system covers overhead twelve city blocks. No damage done and no remarks.

At Sunbury no serious trouble is reported.

At Peru it is in use and has operated without any trouble.

3. The Schuyler arrester has been in use at Canton, O., in the station. It is described as being very good and reliable. No serious damage has occurred.

4. The Swinging Ball arrester has been employed at New Brunswick, N. J.; Peru, Ill.; Canton, O.; Rahway, N. J.; and Lancaster, Pa.

At New Brunswick there have been six swinging ball arresters in use. Very little damage has occurred. No evidence of the arresters having operated.

At Peru three swinging ball arresters have been in use inside station. No evidence of their having operated. No damage.

At Canton, O., some have been in use on poles. No statements.

At Rahway, N. J., the swinging ball arresters have been exclusively used. It is stated that they have been seen to work repeatedly.

At Lancaster swinging ball arresters have been in use. No statements are made concerning their efficacy. It is mentioned, however, that on one occasion an arc circuit operated with an American arc dynamo at 2150 volts, was accidentally opened by a wire slipping from a binding post. The circuit was closed again almost immediately by an attendant, but the lamps would not re-light, and the line showed a dead ground. Search showed that two arresters had allowed a discharge spark to pass at the interruption of the circuit from the balls to the earth plate, fusing these together.

5. Edison magnetic arrester.

This has been in use at West Chester, Elgin, Baraboo, Rochester, Fresno City, Meridian, Hamilton, Evanston, Payne, Nanaimo.

At West Chester these arresters are employed in the station and have been observed to operate two or three times. No further comments.

At Elgin 13 of these arresters have been in use at station. They are regarded as perfect for incandescent circuits, but not satisfactory for 500 or R. R. circuits.

At Baraboo this arrester has been used and has been seen to operate. No further comments.

At Fresno City they have been in use but lightning rarely, if ever, occurs.

At Meridian they have been set up in the station and have been seen to operate ; they are regarded favorably for incandescent circuits.

At Hamilton station they have been installed but not observed to operate. No damage and no comments.

At Evanston they are installed and have given no trouble.

Digitized by Google

At Wayne there has only been trouble in one house, no trouble in the station. An Edison protector was at the station on the circuit of the house in which damage occurred.

6. The Edison condenser arrester has been used at West Chester and at Kansas City.

At West Chester these arresters have been in use both in station and along line. They have been seen to operate and have caught fire at flash.

At Kansas City these arresters have been in use. Two have operated and were destroyed by lightning.

7. The Wason.

Six Wason Arresters have been employed at Elgin, Ill., in the station on railroad circuits. They are stated to have worked well.

8. The Wirt.

Wirt arresters have been used at Grand Rapids, Wilmington, West Chester, Elgin, Brockton, La Crosse.

Grand Rapids has two dozen of these arresters on residence circuits. There has been no evidence of their operation and there has been no damage. Area of territory covered three square miles, and half a dozen severe storms during the season.

At Wilmington Wirt arresters were used on the alternating current circuit along the line. All became short circuited from disk to disk and had to be cut out.

At West Chester one pair of Wirt arresters was connected in the station at bus bars, also one pair on a feeder in station. Several more were connected along the lines. Those in the station are stated to have taken innumerable discharges and no damage is reported.

At Elgin, Ill., about fifty Wirt arresters were distributed along the Railroad circuits, and about 13 on board cars. They are stated to be of very little use on R. R. circuits owing to fusing together of plates at discharge, but that they work fairly well on incandescent circuits.

At Brockton, Wirt arresters have been recently employed, no reports being then obtainable

At La Crosse, Wirt arresters are located in station, also at the end of each feeder, and at the terminus of each line. Incandescent Edison system only. No trouble is reported.

9. The Wurts.

The Wurts continuous current arrester is mentioned to have been employed on R. R. circuits at or near Denver, Colo. Its behavior is said to have been satisfactory at first, but after repeated discharges these arresters were quite disabled.

10. The Westinghouse air-chamber arrester.

These have been used at Wilmington, New Bedford and Trenton.

Digitized by Google

At Wilmington the pneumatic ball arresters have been employed apparently on alternating current circuits at the station. They have been heard to operate many times and spots on the balls also confirm their action. One burned out. They are considered satisfactory.

At New Bedford one of these arresters has been employed in the station. There are no comments.

At Trenton Westinghouse arresters have been used upon alternating current circuits. There are no comments.

11. T. H. magnetic blow-out arrester.

The Thompson-Houston arresters have been employed at : Chester, New Bedford, Paterson, Lawrence, Kearney, Wilkesbarre, Troy, Rutland, Trenton, Sherbrooke, Hamilton, Owen Sound, Brockton, Spokane, Dayton, Leavenworth, Port Hope, Montreal, Winnipeg, Lancaster, Sault Ste. Marie, New Westminster, Denver.

At Chester these arresters have been employed in station on municipal system between dynamo and switch board, and are well spoken of.

At New Bedford T. H. arresters have been used in alternating current circuits in station. No comments.

At Paterson, N. J., four 100 K. W. Ry. armatures were lost prior to the adoption of the T. H. arrester. These are employed on R. R. circuits in station and along the incandescent lines in ventilated boxes supported on the poles. About 35 miles of trolley line, 18 miles of incandescent line of which 12 overhead, 183 miles of arc circuit, 18 sq. miles of territory. The Railroad feeders were first equipped with Edison and Westinghouse arresters of the carbon mechanical brake type. After blowing to pieces a number of each, they were replaced with T. H. arresters. These are commended.

At Lawrence a pair of T. H. arresters is employed with each municipal dynamo in the station, or one pair to 8 circuits. They have always worked well ; armatures were lost by lightning prior to their installation.

At Kearney these arresters have been connected at various points along incandescent lines, and also in station. They have worked well and there has been no trouble.

At Wilkesbarre T. H. arresters are said to be employed on all lines. They are considered to be more reliable than any others tried, but not to be safe on R. R. circuits, for an armature was burned out in a R. R. generator during the first storm after their installation. On arc circuits, several commutators were lost until T. H. arresters were tried, and since then there has been no trouble during the most severe storms.

At Troy T. H. arresters have been in use for both arc and altg. inc. circuits. They have given satisfaction in both cases, and no trouble has been experienced.

At Rutland T. H. arresters have been employed on inc. and arc ccts. They have given satisfaction, and there has been no trouble. They have frequently operated.

At Trenton these arresters have been employed and are commended for arc ccts.

Digitized by Google

At Sherbrooke they have been employed and are commended. No lighting arrester was connected to the machine whose armature was damaged by lightning last season.

At Hamilton the T. H. arresters have been in use on arc and alt. inc. ccts. They are well spoken of, and no damage has occurred.

At Owen Sound an arc system of 70 T. H. lamps is operated from a station outside the town. Trouble was at first experienced until T. H. arresters were connected at station, one on each supply wire. Since then the arresters are stated to have acted efficiently and no trouble has occurred. Occasionally it has been necessary to break the arc at the horns by throwing sand at it.

At Brockton T. H. arresters have been used on arc ccts. and they have proved entirely satisfactory.

At Spokane T. H. arresters have been employed on arc ccts. They are commended and have shown signs of operating.

At Dayton they are connected to arc ccts. On one occasion the two horns of one arrester were fused together.

At Leavenworth they are used on arc ccts., and are commended.

At Montreal they are used on both arc and alt. inc. ccts., and they are considered as efficient as any in use.

At Winnipeg they are used and are commended.

At Lancaster two T. H. arresters were connected to each U. S. arc ccts. in station; they failed to save the armatures of two machines, burned out by light storm.

At Sault Ste. Marie they are employed on both arc and inc. ccts They operate satisfactorily and are commended. There has been no trouble.

At New Westminster they are connected to both arc and inc. ccts., but storms do not occur.

From Denver the report favors the T. H. arrester for arc ccts.

From Scranton, Pa., report favors the T. H. arresters for R. R. ccts.

From Winston, N. C., a report states that Garton arresters operated satisfactorily in cars on R. R. cct., and T. H. satisfactorily on same ccts. in the station.

Concerning preferences, or opinions expressed in favor of particular forms of lightning arresters, twenty-two are for the T. H. magnetic blower, either for all circuits or certain classes of circuit; Westinghouse, one; Edison carbon magnetic brake, 5; Wason, one; Schuyler, one; Wirt, two; Swinging ball, one.

7. *Influence of Grounding the Neutral Upon Lightning Protection.*—The neutral conductor is reported permanently grounded from York, Pa.; Wilmington, Del.; New Bedford, Mass.; West Chester, Pa.; New Brunswick, N. J.; Baraboo, Wis.; La Crosse, Wis.; Rockford, Ill.; Spokane, Wash.; Shamokin, Pa.; Milford, Del.; Canton, O.; Sherbrooke, Quebec; Port Hope, Nanaimo.

The neutral wire is grounded during storms at Hazleton, Pa., and Grand Rapids, Mich.

Digitized by Google

The neutral wire is not grounded in the following systems: Chester, Pa.; Allegan, Mich.; Paterson, N. J.; Tiffin, O.; Williamsport, Pa.; Des Moines, Ia.; New Orleans, La.; Lawrence, Mass.; Kansas City, Mo.; Columbus, O.; Elgin, Ill.; Scranton, Pa.; Renovo, Pa.; Cincinnati, O.; Atlantic City, N. J.; Brockton, Mass.; Sioux Falls, S. D.; Jackson, Mich.; Kearney, Neb.; Wilkesbarre, Pa.; Troy, N. Y.; Tamaqua, Pa.; Middletown, O.; Bellefonte, O.; Dayton, O.; Sunbury, Pa.; Rutland, Ore ; Baldwinsville, N. Y.; Skowhegan, Me.; Peru, Ill.; Leavenworth, Kan.; Fresno City, Cal.; Meridian, Miss.; Flushing, N. Y.; Evanston, Wyo.; Wayne, Pa.; Rahway, N. J.; Newburgh, N. Y.; Lancaster, Pa.; Sault Ste. Marie, Mich.

Of the seventeen stations that have had neutral grounded during thunderstorms, only one, Rockford, Ill., has suffered any other than trifling damage from lightning on Edison system. Rockford has about four square miles of territory, ten miles of pole line. It is reported that there was at least one thunderstorm daily in June, and very severe, each one striking at some place in the city. The neutral is grounded at the poles all over the system, usually at every block corner, and at all dead ends. No other feature of protection against lightning exists. One incandescent dynamo armature was burned out, being the only armature damaged in eight years' experience. The arc system has been fitted with lightning arresters in the station.

Of the thirty-five systems whose neutral are reported as not grounded, two, Rahway, N. J., and Des Moines, Ia., have suffered appreciable damage, and one, Lancaster, Pa., has suffered serious damage on Edison three-wire system.

Des Moines has two square miles of territory with about fifteen miles of pole line, averages one storm per month, and one armature slightly damaged was the only one in four years.

Hazelton, Pa., reports that lightning storms occur with great violence from May to October. That destruction of plugs on consumers' premises is the usual extent of the damage, but very annoying to customers. That last summer, storms were more frequent than ever before noticed, and that last summer the practice was commenced of grounding the neutral during storms at the station. That the trouble from blown fuses along the lines was thereby greatly lessened, though it still existed to an annoying extent.

At Milford, Del., it is reported that great trouble used to be experienced on the Edison inc. ccts. during thunderstorms. "For the first two or three "years we dreaded to see a storm gathering in summer, as they were usually "electrical and gave us a great deal of trouble. The engine (A. & S. 50 "H. P., and No. 8 Ed. dynamos) would be brought to a standstill almost, "the light go almost out, the brushes spark as though we had a dead "short circuit, fire would flash from different points of the dynamo, and the "noise would be like a shower of tin pans striking obstacles round the "room. This would suddenly cease, and our lights would shoot away "above C. P. This was when we were running a jet of cold water from our "pump over each dynamo bearing (old style) to keep them cool. This "seemed to aggravate the trouble. We put on self-oiling bearings, did

Digitized by Google

" away with the piping, and this relieved the station largely, but our cus-
" tomers still complained of a snapping, crackling noise on their wires in
" dwellings and stores, that made them timid and kept them from using the
" lights at first. In one tall dwelling standing off alone, the family com-
" plained of being badly frightened every time there was a thunderstorm.
" One time the lightning came in on third story, followed the wires running
" to a single lamp in the ceiling of the fourth story, and thence to metal
" roof, tearing a hole in it. There was no gas fixture on third or fourth
" stories. The lightning had usually heretofore broken the insulation on
" flexible cord, run off on gas fixtures after lighting all over town, but only
" the above instance where it did further damage. I then grounded the
" neutral main where service wires went to the damaged roof and at other
" points along the lines, and had no further trouble. In fact, from observa-
" tions while working on the lines while these storms have been gathering,
" I believe our wires drain this locality of electricity as a well-planned sys-
" tem of ditches drains a swamp."

Referring in detail to the systems with grounded neutral :

York, Pa., has thunderstorms frequently and very severely ; the neutral is grounded permanently about every thousand feet over the entire line, with no guard or barbed wires ; no damage has occurred.

Wilmington, Del., considers the season of 1892 remarkable for electrical storms, one, in particular, being the most serious ever noted. Edison system one mile radius. Alternating system, five miles radius. About 100 miles of pole line. Edison neutral grounded in the station, at eleven feeder ends, and at about five places along the line. No other protection. Edison system entirely free from trouble. One alternating armature, and 15 transformers burned out, although the alt. cct. have had arresters. When operating railway generators, every armature on the line has been burned out at one time, besides many motors. Very little trouble on arc ccts.

New Bedford, Mass., has had eight or ten storms last season, none violent. The Edison system covers 1¼ x 1½ miles, the lines run for a long distance through trees 25 feet above the street. The neutral is grounded at several places along lines. There is no other protection on that system. The arc and alternating systems have arresters. No damage is reported on Edison system, one or two transformers burned out on altg. cct., and one power motor burned out on R. R. cct., lightning having jumped a T. H. arrester.

At West Chester, Pa., there were eight or ten storms during season ; three or four very sharp ; area 1 sq. mile, 6 miles of length. Neutral grounded at unknown location. No damage to this or arc system. Since the street railroad system has been put in operation, there has been almost no trouble from lightning on the arc or incandescent ccts., but whether this is coincidence is not decided. The town is square, and the railroad divides it in halves along two perpendicular diameters, but does not nearly cover the area occupied by pole lines.

New Brunswick had an area covered of 15,000,000 sq. ft., and 7 miles of line. The neutral is grounded, and there are no guard or barbed wires.

Digitized by Google

No other protection to Edison system, and only trifling damage to fuses, etc.

At Baraboo, Wis., storms have occurred nearly every week in season The neutral is grounded in river beneath power house. There are also Edison arresters in dynamo room. These latter have been seen to operate, No damage has occurred

At La Crosse, Wis., storms have averaged 2 or 3 per month during season; two very severe, and one lasting four or five hours. The area covered is about 3½ sq. miles, and some lights 1½ miles from station. The neutral is grounded at the station, at the end of every feeder and at the terminus of every main. There are also guard wires, and they are grounded. There are also Wirt arresters in station. There are no arc altg., or R. R. system. Only damage to fuses and arresters has occurred.

The case of Rockford, Ill., has been already discussed above.

At Spokane, Wash., two or three sharp thunderstorms occur usually during season, but really severe thunderstorms are almost unknown. The area covered is about 1¼ sq. miles, with a total of eight miles of pole line. The neutral is permanently grounded at the station, and there is no other protection for the Edison system. There is an arc system with arresters on it. There has been no damage done.

At Shamokin, Pa., thunderstorms occur frequently and severely. The area covered is about 1 sq. mile, with 2 miles of pole line. The neutral is grounded in the station, and there is no protection on the Edison system. There is an arc system. No damage has occurred.

At Canton, O., storms occur weekly during season. The neutral is accidentally grounded. The Edison system has also arresters. No damage beyond fuses.

At Elgin, Ill., the ground on the neutral had to be removed, for the reason that a cross between the Edison system and the R. R. system might, with ground on both, prove very serious.

At Atlantic City, the ground on the neutral had to be removed on account of trouble caused thereby. The nature of the trouble is not mentioned.

8. *Influence of Barbed or Guard Wires Overhead on Lightning Protection.*—Overhead guard wires, supported on poles above the Edison conductors, are in use at the following stations:

Allegan, Mich; New Orleans, La.; Elgin, Ill.; Renovo, Pa.; Denver, Colo., La Crosse, Wis.; Sioux Falls, S. D.; Kearney, Neb.; Sunbury, Pa.; Baldwinsville, N. Y.; Lancaster, Pa.; Grand Rapids, Mich. Of these 12 stations, only Lancaster, Pa., has suffered any but trivial damage.

Allegan has a barbed wire, grounded at every second pole. Bad locality for lightning, 4 sq. miles of territory, with inc. street lights 50 in number. Neutral not grounded, no arresters. Brushes used to be badly burned from lightning before barbed wire was put up, and when entire system is covered no further trouble is anticipated. Galvanized barbed iron wire above conductors is considered to be the best lightning protector.

New Orleans has guard wires of small bare iron wire over about one

Digitized by Google

third of its lines. Neutral not grounded. No arresters employed. Wires run to a great extent beneath other systems of conductors in city. No damage from lightning.

At Elgin, Ill., barbed wire has recently been suspended from poles 18″ above feeders, over a portion of the road, and it is intended to extend this over all the road.

At Renovo, Pa., a barbed wire is employed as sole protection. The neutral is not grounded, there is no arc or R. R. system, and the pole line is about one mile long. Thunderstorms are infrequent, and no trouble has occurred.

Mr. Ford reports from Denver that it has been found advantageous in mining and transmission plants to erect a ground, wire usually barbed, above the conductor, and to ground this wire at every three hundred or six hundred feet. This protection becoming more serviceable as the line voltage increases. The following is a quotation from his report:

"In Colorado, about twelve miles from Ouray, is situated the famous "Virginius mine, at an altitude of about 12,500 feet, or about 2,000 feet "above the timber line. On a stream about three and three-quarter miles "from this mine is water power and electric station at an altitude of about "3,000 feet. About a quarter of a mile from this mine the line passes over "what is called the 'Hog's Back,' the highest point in the line, where the "altitude is about 13,500 feet. Lightning is very frequent and severe. In "most storms the clouds strike this line at some elevation, the termini of "the line being both above and below the clouds. The generators have a "capacity of 300 H. P., and the amount transmitted for operating the mines "is 280 H. P. The voltage is 900 at station and 800 at motors. Machines "specially designed, but with ordinary insulation. The generators consist "of one 100 and two 60-KW. machines. The motors, etc., of three 6 -KW., "three 20 KW. and one 15-KW. machines. This installation, however, was "not undertaken by myself until fifteen months after it was begun. As "originally planned with ground return, having two No. 00 bare copper "wires overhead on the one side, and an immense copper coil at station at "one end, and at mine at the other, buried in the ground and connected to "opposite pole to constitute ground return. Under these conditions "lightning had no alternative. It was compelled to pass through the "machines to get to ground, for lightning arresters in this case had been "forgotten altogether. The ground return was abandoned and the overhead "wire alone was used, one on one side and one on the other, and yet "without arresters lightning was very destructive, and the capacity of the "line too small. Up to this time a car-load of armatures and field coils had "been destroyed by lightning, and the plant had been unable to operate "only a few hours or a few days at a time, before the available parts were "destroyed. The job then came into my hands. I increased the line by "adding two heavily covered No. 000 wires, which were erected about two "feet underneath the two No. 00 bare copper wires before mentioned. The "two No. 000 covered wires formed one side of the circuit, and the two No. "00 bare wires the other side. Then connected both Wason and Edison

Digitized by Google

" 1,013 arresters, the only ones we then had, on to both sides at the stations " where they were easily accessible to the operator. But these were not " considered safe, and for absolute protection I had the old ground return " supplemented by 4,000 feet of large water-pipe, connected in multiple with " two No. 00 bare wires.

" This arrangement gave an absolute and perfect protection against " lightning, although the danger of machines burning out thereby was " naturally greatly increased. But this danger was almost nothing com- " pared to that from lightning. This ground connection was maintained " during lightning season only, and often during this time was disconnected " when the weather was not threatening. Since the arrangement was " adopted there was no trouble from lightning, and the plant has been run- " ning continually through the past lightning season."

La Crosse, Wis., employs grounded guard wires. The neutral wire is also grounded and Wirt arresters are also in use. No damage other than trivial has occurred.

Sioux Falls has guard wires (barbed) over entire length of conductors. These are recommended as the best lightning protector. There has been no trouble from lightning during five and a half years, and about six severe storms occurred last season.

Kearney, Neb., employs barbed wire; has frequent and severe storms; two square miles of area and twelve miles of pole line. T. H. arresters in use. No trouble

Sunbury, Pa., employs barbed wires above conductors, and grounded. There is an arc system. The Edison neutral is not grounded. The Edison arrester is in use. Storms frequent and severe. No trouble.

Baldwinsville, N. Y., has guard wire above conductors, and this grounded. No arresters, no arc or R. R. ccts. Storms frequent and severe. About nine miles of pole line. No trouble.

Lancaster, Pa., had an iron barb wire put up several years ago, but nearly all is now rusted out.

Grand Rapids has guard wires over most of system. Three square miles of area, five miles of pole line. Neutral is grounded temporarily during storms, and Wirt arresters are also in use. There is an arc system with its arresters. Barb wires are recommended as the best form of protection.

9. Resumé of data and information gained from returns.

Six stations report that the year 1892 was exceptional for the severity of its thunderstorms, all of these being eastern stations.

Thunderstorms are severe in the eastern and central States, the frequency depending principally upon local conditions. On the Pacific coast they appear to be rare. San Francisco and Fresno, Cal., report none. Seattle, Wash., and in the Puget Sound regions, lightning has only once been seen a long way off, although at Spokane, Wash., two or three storms occur yearly. At Pendleton, Ore., the report states that storms do not occur once a year, and then very light. In the Rocky Mountain district there is stated to be much trouble, lightning discharges frequently taking place when the sky is perfectly clear.

Digitized by Google

About half the stations heard from have had no trouble whatever during the past year from lightning. About ten per cent. have, however, suffered severe damage, and about ten per cent. more, appreciable damage. The principal damage has been in railroad generators and motors, also in alternating current apparatus. The usual damage on Edison system has been the blowing out of safety fuses in customers' premises, and sparks at gas fixtures. Rochester, N. Y., once had the cover of a catch box blown up from the effects of lightning, and Chicago had lightning discharge enter the station by the smoke stack.

Of all the lightning protectors that have been in use, the Thomson-Houston magnetic blower arrester is by far the most popular, holds the best record and receives the most general recommendation. Occasionally it has failed, apparently, to protect railroad ccts., and in one case it is stated to have failed on U. S. arc ccts. The Edison carbon arrester, with magnetic brake, comes next, and is recommended for incandescent lines, but was not so well adapted to railroad circuits. The Wirt is well spoken of for Edison incandescent systems, but it appears to have failed on high tension circuits.

There is strong evidence in favor of the protection afforded to any system of overhead wires by the erection of a guard wire of galvanized iron above the conductors, when the guard wires are grounded at frequent intervals. Two or three stations consider this protection superior to any other method, and have adopted it with success.

There is also strong evidence in favor of the protection afforded to Edison overhead systems by grounding the neutral conductor either temporarily at the station during thunderstorms, or permanently at various places along the lines. Several stations consider this plan, in itself, sufficient protection against the effects of lightning.

There is also evidence in favor of the protection afforded to a system of overhead wires by supporting them on the same poles with other systems of conductors, but underneath, the upper wires on the same poles acting as shields to the lower.

It is shown to be dangerous to connect waterpipes to the iron framework of generators in a central station, and the insulation of the armatures and machines generally should be maintained as far as possible.

It may be inferred that the best way to protect an overhead circuit of any description is to suspend a galvanized iron grounded guard wire above it. The generators should be carefully insulated, and the arresters connected at the bus bars, or just outside the station, the ground wire making as direct a course as possible to waterpipes, tank, well, or, failing these, to buried plate in moist earth.

In Edison systems temporary or permanent grounding of the neutral is also a protection, although even with guard wires, grounded neutral, and arresters at the station, fuses may be carried away in customers' houses, and sparks pass to gas and waterpipes. To reduce the chance of this occurring, where the expense is warranted, arresters might be placed on the

Digitized by Google

lines outside the premises supplied. Such arresters might be the T. H., the Edison carbon point magnetic brake, the Edison condenser, or the Wirt.

A. E. KENNELLY, Chairman,
WILSON S. HOWELL,
F. E. JACKSON.

On motion the Report was received and ordered spread upon the Minutes, with the thanks of the Association.*

Relations between the Association and the General Electric Company.

MR. GILBERT: Concerning the Edison Lighting Companies, as distinguished from the General Electric Company, I see Mr. Greene is present. I am sure all would be glad to hear the latest news.

MR. GREENE: Mr. Chairman and Gentlemen of the Association: Assuming that you would be interested in the status of the patent situation, we have requested one of our counsel, Mr. F. P. Fish, to come to Chicago prepared to address the Association. As you all know, the patent question is almost entirely a legal matter, and one that a layman is hardly competent to talk upon, and I think I had better not say anything further than the fact that Mr. Fish is here in Chicago, and would be very glad to address the Association upon that subject at any time that would be convenient to you. We have made some material progress, as you know, in litigation during the past year, and, from the talks that I have had with our counsel, we hope to make considerable more within the next two or three months. What we have done and what is contemplated, I know Mr. Fish can tell you better that I can. I would say that these suits are all in the name of the Edison Electric Light Company, and, in some instances, that company has joined the Edison General Electric Company. In fact, the Edison General Electric Company has, in many cases, installed lights under the name of the Edison Electric Light Company under the letters patent. It has, therefore, been thought best in the later suits to join those two companies together as plaintiffs. Mr. Fish will, in addressing you, therefore, speak to you as one of the counsel of the Edison General Electric Company. Mr. Fish has done more in the past year, perhaps, than any other one man in pushing to completion the suits that are now under way.

THE PRESIDENT: We were just remarking, Mr. Fish, that as we understood you wished to return to Boston very soon, we had better hear from you as early as possible.

MR. FISH: I thank you very much for that, because I do want to get away.

I shall be very glad to give you a very brief resumé of what has been done by our Patent Department during the past year, and to offer a few sugges-

*The statement received by the committee from Mr. Wuestenfeld of Elgin, Ill., was so suggestive of practical information to the managers of central stations that a letter was written inviting a more detailed description of the methods pursued at Elgin, where it would appear that lightning is especially frequent and severe in its effects. The reply will be found in Appendix A.—SECRETARY.

Digitized by Google

tions as to the present situation. Of course that is of more interest to us all than any ancient history, even if the ancient history is only a few months old.

As you know, when the last Edison meeting was held in Toronto, a year ago, the main suit on the lamp patent was still pending before the Court of Appeals. It had taken from 1885 to carry the case to that stage. The case was decided the 2d day of October last, and was decided, as you all know, in favor of the Edison Company, and in terms that were extremely satisfactory, to the effect that Mr. Edison was the first inventor of the lamp and that the patent belonged to him and to you, gentlemen, for each of you for your respective territories has acquired the rights that accrue under that patent. We had been expecting that result and were ready for it. I should like to call your attention, in justice to the parent company, to the way in which we went to work to make that victory effective. Several things were perfectly clear to us, who were considering this matter from its immediate neighborhood. One was that, in a way, the interests of the General Electric Company, as owners of the Edison patent, were not the same as those of you, gentlemen, the licensees. Another was that the interests of the parent company must be sacrificed for the sake of the licensees, and we adopted a policy based on this last proposition, and have adhered to it. The patent had been infringed for a great many years, and you know that these infringers had, so they say, the sum of twenty-five million dollars invested in the apparatus and plants involved in infringing the Edison patent, and in carrying on the rival incandescent light business in this country. The easy, simple and safe way for the General Company was to devise some plan to sell lamps to everybody, but we felt that you, the licensees, had independent rights that must be protected. The question, how was the victory to be handled in such a way as to save from the wreck something for you has been uppermost in our mind throughout. To begin with, we appreciated the fact that there was no use talking to you. or trying to help you in your respective territories if the infringing lamp manufacturers were allowed to continue manufacturing. There could be no possible protection to you if parties could get all the lamps they wanted by simply writing a letter to a company in Chicago, or to one in Ohio ; so it was perfectly clear to us that it was necessary for us to deal immediately with the manufacturers. There was hardly a manufacturer in the United States who did not come to us with liberal propositions for a license, but we found that it was impossible to grant licenses to the manufacturers and at the same time protect our licensees. We negotiated with some of these manufacturers, but as we could not license them, in fairness to you, our negotations failed.

That decision was only rendered on 2d October, but we soon had the Sawyer-Man Company under injunction, and had secured from the Court of Appeals a decision in our favor, as to the alleged laches of the Edison Company and other peculiarities of the situation that remained undetermined in the first case. Then we proceeded against other manufacturers, and soon had the Westinghouse Company, the Perkins Company, and, as you all know,

Digitized by Google

the Beacon Company, under injunction, and restraining orders against three concerns in the West. In the Beacon case the Goebel defense was sprung on us at the very hearing. We met it and succeeded in thoroughly satisfying the court that there was no validity whatever to that defence.

Then came the St. Louis case, and it almost brings tears to my eyes when I think of that case. This is not, however, the time or place for me to go into the reason why an adverse decision was rendered in St. Louis. I think you gentlemen understand pretty well how it happened. The Goebel defense that we had so successfully met at first, was there sustained, the court deciding that there was not sufficient evidence in behalf of this old Edison patent that had been in litigation for eight years and had been sustained so many times, to justify him in granting an injunction. We felt that the decision was erroneous, but, at the same time, it embarrassed us greatly, especially as, under the law, we had no right to appeal. While Judges will sometimes follow each other in supporting a patent, not blindly but under the rules of the law, they are even more likely to follow each other in overthrowing a patent. The situation was critical, but we adopted what we considered was the wisest course. We decided not to acquiesce in that decision but to make, in a new case, the strongest fight possible in the interest of the parent company and licensees; that is, we proceeded at once to try the case over again. In the Oconto case we secured from Judge Seaman, of Milwaukee, a decision that is exceedingly strong to the effect that the Goebel defence was not so clearly made out as to deprive us of our right to an injunction. I no longer fear that defence. One result of that decision was, I think, illustrated in Ohio, where I proceeded recently against the Buckeye Electric Company and the Packard Company. The Buckeye Company made no resistance, but at once consented to a restraining order which is not returnable until fall, and a restraining order was issued against the Packard Company. I have no doubt that the result in Ohio in the Packard case will be the same as in the Oconto case in Milwaukee. A number of other manufacturers have been closed, and we are now on the threshold of suits against other companies. It has not been a favorable time to proceed against users of lamps, for it would be, as I have already stated, almost hopeless to accomplish anything while these manufacturers were in the field supplying lamps right and left, regardless of the licensees' territorial rights, and putting in their lamps on the strength of promises and guarantees, and tales of new defences springing up, and things of that sort. But, as you know, we have started in in New York, where we thought it altogether wise to commence the proceedings. We selected New York because the Judges at that point are thoroughly familiar with the litigation and the nature of the defenses, and, in the next place, because in New York the rights of licensees, situated as you are, have been many times before the courts, and the courts recognize your rights to protection in your territory. We proceeded against the Holland House and Imperial Hotel and secured injunctions; each had put in its plant quite recently and subsequent to Judge Wallace's decision. A third defendant also enjoined was a customer of the Mount Morris Company. These hotels are under injunction, and I

will tell you later just exactly the bearing of this litigation on the lamp situation, and some of the lessons to be learned from it.

Then we proceeded to the consideration of one of the most serious questions in this great aftermath of litigation, that is, the rights of the Edison Licensees against the infringing lighting companies which have enormous investments and which have been serving the public for many years.

A word as to the granting of injunctions; you, gentlemen, understand that a preliminary injunction may be refused no matter what the plaintiff's rights are in the case. It is a matter left to the discretion of the Court, which has to take into account all kinds of complications and considerations. In the first place, as to the plaintiff's right. The Court may refuse to grant an injunction if in its judgment the plaintiff's right is not clear, as was the case with his Honor Judge Hallett at St. Louis in considering the now discredited Goebel defence. If the right to relief is clearly shown the Court will sometimes refuse to enjoin a company when it would work a greater hardship to the defendant than benefit to the plaintiff. These questions are not easy to discuss, and I think you will readily see that there are a great many phases to them which it would not be wise to develop very fully at this time and place. I have always talked more frankly before your Committee than I would feel at liberty to do before as large an Association as this. I shall be glad at all times to meet any committee that you may select on this subject.

The hearing of the motions for a preliminary injunction in our cases against the Westinghouse and United States Central Station companies, who have been infringing the Edison lighting patent in New York since 1882, and the Mount Morris Company, which has been doing business since 1888, were assigned for argument for last Wednesday. All kinds of questions are coming up in these cases. All that was done last Wednesday was simply this: These defendants asked for time, and we emphatically said that we did not feel at liberty to give them time, because the Edison patent was running out and that we thought that they did not require more time. Now the Court saw fit to give them until next month for preparation. After this delay we shall proceed to argue and settle these particular questions as to whether we are entitled to relief against companies who carry on business to the extent and in the way that it has been done by those New York companies. I regret to say that the western papers (I saw nothing of it in the eastern) have published an absolutely untrue and unfair account of these proceedings. I think that probably many of you have seen that account. It was in the Chicago and possibly in the Kansas City papers.

MR. EDGAR: I understand that there was such an account in the Boston papers, but it has so happened that I have not seen it in any paper.

MR. BEGGS: It appeared in the *Mail and Express.* I think it appeared in the *Mail and Express* and western papers simultaneously.

MR. FISH: The fact is, in our motion for preliminary injunction, the papers having been served but five days, the defence claimed that they did not have time to answer the voluminous affidavits and papers in evidence. There was no doubt whatever that the Court would grant them a postpone-

Digitized by Google

ment. He said : " I will give you until the first of September." The giving to them of that postponement was not unreasonable, as it is not uncommon for the Courts in cases like this to grant from 30 to 60 days.

I want here to point out one or two dangers in the situation. In the first place, the Court in New York, when it comes to pass upon these New York cases, may feel that an absolute injunction against the illuminating companies who have been in business a great many years, as these defendants have been, will be too great a hardship upon them. This is not the place to go into the legal refinements of the matter, or to go into it at any length.

There is another point that I want to impress upon you, gentlemen, because it is important that you should see not only the things that are in your favor, but also those that are working against your interest, and that is in regard to those new lamps. I firmly believe that the " Novak " and the " New Sunbeam " lamps infringe the Edison patent. Then there is another new lamp trying to get a hold on the trade, namely, the " Stopper" lamp. This, in my opinion, is not going to be a success, in spite of what you see here on the grounds. Those who know more about the technical features can tell you more than I can in reference to these lamps. Mr. Howell and Mr. Page can tell you all about them. The questions raised by these new lamps have not been definitely settled by the litigation of the past, and we propose to settle them just as soon as we can. Meanwhile, the greatest precautions on your part are necessary to prevent your competitors from getting standard Edison lamps. The General Electric Company takes such precautions that a competitor can get them in the territory of one licensee only through another license.

Now, as far as this lamp litigation is concerned, we shall bring all these new questions to the front just as soon as possible ; but, in all of these matters, we have got to look all along the line and to take our action in due course, one step after another, or we may meet with a reverse which will be worse for us than the one at St. Louis.

I have told many of you during the year, and your Committee that, so far as the relations existing between the General Electric Company and its licensees, are concerned, each licensee had rights in his own territory, and if he chooses to go ahead and enforce those rights, he may do so ; but I have always warned the licensees not to act too hastily. If, however, a licensee elects to go ahead, our legal force, and every element under our control that would contribute to the success of the licensee in his territory will be brought to bear in his favor. I ask you, individually, as I have asked the Committee, to consider, in every case, whether it is really in your interest to enforce this patent in your territory at that particular time, and to consult with us about it before taking any steps. But, when you have made up your minds, and have concluded that you must go ahead, and that none of the considerations which I or other members of the General Electric Company might urge, are valid reasons for further delay, proceed with the litigation and we will back you up all we can. In this connection I should like to make a sort of half personal explanation, not only on my own be-

Digitized by Google

half, but on that of the company which I represent. You have no idea how much strain there has been upon the legal corps in all this litigation during the last year.

The legal expenses during the last year were enormous, three-quarters of which was in suits on this lamp patent. You can see something of the magnitude of the matter when I tell you that Mr. Seward, Mr. Dyer, Mr. Mitchell, and many others have been occupied almost altogether upon these cases, and a great part of my time has been put upon them. Moreover, Mr. Howell, Mr. Page, Mr. Hammer, and all the rest of our experts, have spent a good part of their time in this litigation. We found this Goebel defence one of the most vicious we ever encountered, false as we believe it to be from start to finish. When you come face to face with one of those defences, common in patent cases, but based upon half truths and the faulty recollections of men, recalling vague impressions of events that happened 10 years ago, 15 years ago, or 40 years ago, if there is anything true in the story at all, you can generally find out what that truth is, and by developing the grain of truth show what is false. But in the Goebel defence, which we believe to be false from start to finish, Judge Seaman, at Milwaukee, Judge Colt, of Massachusetts, and Judge Hallett, in St. Louis, before whom this defence was made, were all obliged to consider evidence and affidavits of witnesses to alleged facts for which there was no shadow of foundation, and lacking even the kernel of truth which, in most cases of the kind, is the basis for the extraordinary exaggeration and false recollection.

Now you can see what a difficult task we had before us, and how much energy we had to put forth in pushing these cases. I think, however, that the Goebel defence is now out of the way.

I make this explanation on behalf of our Legal Department; there has been no time wasted by us that could possibly be saved, and I can safely say that I have never known a litigation that has been pushed so vigorously and incessantly as this lamp litigation during the past year.

I know the difficulties you labor under in your territories. I recognize, too, that out there in your territories some of you are not in touch with, and do not know the tremendous difficulties that we have encountered and are encountering to-day. We do not want you to feel that we are neglecting you. If any of you want to start in to protect your rights in your own territory, as I stated before, we will give you all the backing we can, without neglecting the enormous tasks and complications we are laboring under at headquarters in trying to fight this matter systematically. But all of our counsel are absorbed, and all of our experts are absorbed, in this work, and I cannot advise you to go into this matter independently of us. If you do you will soon find that the best patent lawyer in the United States will be of very little value in this litigation as compared with Mr. Dyer, for instance, who is able to put his finger upon every point of this whole litigation, and is always able to control and carry the Court with an argument on the technical parts of the case that is unanswerable. No one else has "lived" in the case as he has, and no one can make this same argument with the spirit and vigor that he can. I should be very sorry to have any case that

Digitized by Google

goes to the merits argued unless Mr. Dyer was there to present this particular argument, which, as I say, no man can make but Mr. Dyer. That may seem to you a strong statement, but, after you have had experience in this matter, you will find that this complicated litigation requires a man fully informed as to the old records to present the case clearly and intelligently to the Court. But Mr. Dyer can attend to only a few cases at a time.

In regard to these new lamps, it will do no harm for me to tell you just the difficulty in the situation. It is claimed that the "Novak" lamps have gas in them; that they have gas in them instead of having a vacuum. I do not myself believe that they have an appreciable amount of gas in them. If they did, I do not think that the lamp would be a practical success. On the other hand, even if they pump into the exhausted bulb a little gas (chlorine, or whatever it may be—I am not posted on these chemicals), it is our lamp. I myself believe that as far as any commercial lamps are made, in which there are any so-called gases, they will be held to be under the Edison patent.

There are two or three other matters I want to call your attention to. In addition to the lamp business, we have been as active as possible in other directions the past year.

In the first place, no suits have ever been brought against the infringers of the Edison Socket Patents. Some of these patents are as broad in their terms as the lamp patent. We have suits pending which will be argued in the Fall. These socket patents, I think, can be made very useful if we have the good fortune to have them sustained, as we confidently expect.

The Edison Feeder Patent has been sustained. Just what the value of that is, however, at the present time, to you, gentlemen, I don't know, but I find a great many of your competitors prefer to use an extravagant amount of copper rather than use that patent. However, the Feeder Patent is a very good patent. It is practically impossible to install a low tension system without the use of the Edison Feeder Patent.

Another thing we have done the past year is to start a suit on the 3-Wire Patent. Not many use it, but I regard the 3-Wire Patent as a "Tower of Strength" to the Edison licensees, because it seems to me that it would be impossible for a direct current system of light and power to be installed on anything like a large scale without using the invention of that patent, and that patent has several years to run, and is not interfered with at all by any foreign patents. At the next meeting, I have no doubt we will be able to tell you that that patent has been sustained.

I think it is highly probable that I have wandered from the subjects that have interested you most, and, in that event, I shall be glad to have you ask me any questions you choose, and I will answer them to the best of my ability. I anticipate one or two, perhaps. For instance, the difficulty that arises from the lamps of one licensee getting into the territory of another. I wish there was some way of removing that difficulty. I can only say that, at very great sacrifice to the General Electric Company, it has done all that it could to prevent this. It has absolutely cut off the sale of

Digitized by Google

Edison lamps to supply dealers, as it was found that lamps would certainly get from their hands into territory where they did not belong. It seems that the difficulty can be met only by the exercise of great care on the part of the licensees, and on the part of the parent company in making sales. I can assure you that, as far as I know, every means is taken by the parent Company to protect fully the licensees. Yet, unfortunately, there are cases where the lamps get from one territory into another. I do not think this is through the fault of the licensees, but generally through lack of good faith on the part of the customer in buying lamps for use in one place and shipping them to another. I am very hopeful that the courts will protect the licensees against the wrongful use of Edison lamps in their respective territories, but the law on this subject has not been definitely settled. If we are ever able to find a clear case, the history of which can be traced, we shall invoke the aid of the courts, and secure a definite determination of this question.

MR. EDGAR : How about the lamp repairing business, as it is being carried on ?

MR. FISH : The lamp repairing business as carried on in this country is, in my opinion, an absolute infringement on the Edison patent, and is going to be stopped.

I have tried to be frank, and have tried to state to you nothing at this time but what will be justified by the events of the future. I thank you for the privilege of coming before you.

Mr. Coffin wished me to express to you his regrets that the condition of affairs in the East made it impossible for him to be here at this time ; and he wanted me to tender to you, on behalf of the General Electric Company, the most cordial invitation to make Boston your next meeting place. While Mr. Edgar and his Company would need no assistance in making your visit to Boston as agreeable as possible, he may rely upon the hearty co-operation of the General Electric Company and its Officers, who would take the greatest pleasure in sharing with him the duties of host.

On motion of Mr. Dickson, a committee of three, consisting of Messrs. Dickson, Pryor and Weeks, was appointed by the Chair to draw up a form of contract covering lamp orders, renewals, etc., and consult with Mr. Fish during the afternoon, and report to the Association.

Digitized by Google

Mr. Stieringer's Paper.

THE PRESIDENT: We will now hear from Mr. Stieringer on "Electrical Engineering at the Fair: What to see and how to see it."

Electrical Engineering at the World's Fair. What to See and How to See It.—By L. Stieringer, Consulting Electrical Engineer, World's Columbian Exposition.

The Executive Committee of the Association of Edison Electric Illuminating Companies requested me sometime ago to prepare a paper for the information of the delegates to their Convention, reviewing the many electrical attractions to be seen at the Chicago Exposition, presuming that, as Consulting Electrical Engineer of the Exposition, I had a fair idea of all the most striking features. Unfortunately, my time has been so fully occupied since the request was made, that I have found it almost impossible to obtain the necessary leisure to cope with a task, with the magnitude of which, I am afraid, the Executive Committee was not fully acquainted when it made the request. I must, therefore, offer my apologies for any shortcomings which this review may present. As an aid to the members of the Association, I have prepared a map of the grounds, upon which I have marked the location of the different points of electrical interest referred to.

The magnificence and profusion of the electrical effects at the Columbian Exposition exceed in extent everything hitherto attempted elsewhere, and render the effort of enumerating them adequately one of extreme difficulty. Roughly, the electrical side of the Exposition may be divided into two classes. First: Electricity as utilized by the Exposition Company for illuminating the buildings, for power purposes, and for the production of special effects. Second: Electricity as employed by exhibitors for the illumination and enhancement of their own special displays, as well as the electrical exhibits in the Electricity Building

The service installation forms a working exhibit of the best and newest in every branch of the art in commercial use, and shows the enormous resources of the electrical industries of this country. It is the greatest and most complete electrical installation ever projected, and may be divided into the following classes:

Arc Lighting.
Incandescent Lighting.
Electric Power.
Electric Transportation.
Telegraph Service.
Telephone.
Police Signal.
Fire Alarm.

Digitized by Google

Digitized by Google

Digitized by Google

Inseparable from all these is the ingenious system of electrical canalization—the subway and ducts, which merits examination as embodying the most modern methods.

A fair idea of the magnitude of the installation may be gathered from a comparison with the last great International Exposition immediately preceding this.

At Paris, in 1889, the total steam power devoted to electrical use was 3,000 horse power. At Chicago, the engines devoted to electric light and power, in the main power plant alone, aggregate 17,000 horse power, of which 3,000 horse power is devoted to the electrical transmission of power, and 14,000 horse power to producing electric light. About 1,000 horse power in addition will be supplied for light by exhibitors in Machinery Hall, and in small isolated plants. To this must be added, if the comparison is to be complete, the plant of the Intramural Railway Company of about 5,000 horse power.

The Electric lighting of the last Paris Exposition was furnished by 1,150 arc and 10,000 incandescent lamps, giving a total of about 1,600,000 candle power. The contemplated lighting required by the Exposition Company and contracted for at Chicago, was about 90,000 incandescent lights of 16 candle power, or a total of 1,440,000 candle power. and about 5,100 arc lamps, with a total of 10,000,000 candle power—a grand total of about 11,400,000 candle power. The contractors for the incandescent light, for various reasons, have so far not placed more than about two-thirds of this number of lights.

The total capacity of the generating plant is about 5,000 arcs of 2,000 candle power each, and 120,000 incandescent lights of 16 candle power, which is a reserve sufficient to operate 30,000 incandescent lamps above the number contracted for. It appears, then, that the plant is approximately between seven and eight times the size of the plant at Paris. The lighting at Paris necessitated the formation of a syndicate of over twenty of the leading Companies. The lighting at Chicago is furnished from the standard apparatus of four leading American firms, with a few minor exceptions.

From Machinery Hall leads a subway or tunnel, which is a lighted passage nearly square Thence it runs to Electricity Building, and to the Mines and Mining Building; thence to the bridge on the west of Manufactures Building, under which the conductors are fastened. On the other side begins another subway like the first mentioned. This runs along the entire west side of Manufactures Building, 1,700 feet; the distance from the bridge to the west line is 300 feet; the subway continues under the north portico of the Manufactures Building, stops, crosses the bridge to the north, as it crossed on the other bridge, and then begins again underground and runs over to the Fisheries and the Government Buildings, where it stops. The entire way is lighted with sixteen-candle power 100 volt incandescent lamps, placed in series across the 500 volt power circuit wires that are attached by glass insulators to the ceiling. The subway is double from Machinery Hall to Electricity Building, where it divides. Each section is the same in size and appearance, that is, six feet six inches square, built of

Digitized by Google

two inched tarred planking spiked to three by eight inch timbers set twelve inches apart, and made fireproof by an inch coating of cement held in position by expanded metal lathing.

Provision is made for supporting 240 large conductors on glass insulators in both main sections, and, in addition, telephone and fire alarm service cables, containing innumerable circuits, are also provided for. Connections with this subway and its branches are made with the main buildings through trap-doors, and along the line by 1,500 manholes. Also connecting with it directly and indirectly are nearly ninety-three miles of six inch "pump logs" placed in trenches. These accommodate telephone and telegraph lines for fire alarm purposes, as well as the subsidiary light and power conductors.

For the electric power circuits in this subway, 200,000 feet of conductors were laid. For fire alarm and police signal service, 350,000; for the telephone circuits, cables for main distributors, equivalent to 750,000 feet of metallic circuit have been furnished; for branch conductors, 100,000 feet of insulated wire, each wire being separately braided and the two twisted together; for the arc light circuits, 264 miles of conductor, and for the incandescent circuits several hundred miles of wire; and of smaller wires several million feet are used in the buildings, while a half million feet of larger size were used for main feeders.

In addition, there are miles of Edison underground tubing to supply current to the Electrical Fountains, and to charge the batteries for the launches at the station at the extreme end of the Agricultural Building; also for conveying current in large quantities to Electricity Building.

The lights along the roadways and the numerous steady glows on the wooded island, likewise the illumination of the domes, attract the attention. In Machinery Hall, that palace of mechanic arts, with a floor space equal to twenty-six acres, seven acres have been given over to the power plant, the heart or center of all electrical requirements.

It is from this plant that nearly all the buildings are lighted and supplied with electricity. The plant is the solar center of the Exposition.

The arc lighting may be subdivided under two heads: exterior and interior lighting. Of the 5,000 lamps used, 1,600 are employed in the illumination of the grounds, and 3,400 for lighting the interiors of the different buildings. The lighting of the grounds is effected by lamps placed at intervals of seventy-five or one hundred feet in single lights, or in clusters of two or three, principally on ornamental posts. The lamps are placed at suitable distances from the buildings, and the whole system is arranged with a view of securing equal and most economical distributions. All the globes are opalescent.

My original estimate contemplated 7,000 lights, in order to brilliantly light desirable portions of the grounds. I feel confident that had these plans been carried out, the results obtained would have been far more satisfactory. The Exposition management, however, considered only two plans: a moonlight effect on the grounds, produced by radiation from the interior of the buildings, and the maximum of lighting finally adopted.

Digitized by Google

The interiors of such Exposition buildings as depend on arc lamps for their general illuminations are as follows :

Manufactures and Liberal Arts Building	1,200	arc	lamps.
Agricultural	500	"	"
Transportation	350	"	"
Transportation Annex	150	"	"
Horticulture	250	"	"
Mines and Mining	200	"	"
Fisheries	50	"	"
Machinery Hall	250	"	"
Machinery Hall Annex	160	"	"
Illinois State Building	77	"	"

In the lighting of these buildings there are several interesting effects.

The arc lighting of the interior of the dome of the Horticultural Building presents a fine effect when viewed from the grounds. The lamps are arranged just below the interior cornice, at the base of the glass portion of the dome, so that no direct light can be seen from the grounds. The result is that this immense dome appears like a brilliant hemisphere of light against the dark back-ground of the night.

The interior of the dome of the Administration Building is also illuminated to some extent by arc lamps. Far up above the top-most gallery and between the false dome and the outer dome is a hidden circle of arc lamps, which serves to illuminate the painting on the outer dome, which can be seen from the floor of the building.

The grandest and most effective arc lighting is that of the Manufactures and Liberal Arts Building. The immense size of the interior of the building —1,275 feet long, 380 feet wide and 210 feet from the floor to the center of the arch of the great girders—presented obstacles of no mean order to its illumination by methods hitherto alone deemed practicable. Inspection will reveal that the method adopted is an original and radical departure in lighting practice. The plan carried out has provided five immense coronas, the largest of which hangs at the exact center of the building, having two smaller ones on each side of it at equal distances apart. The coronas are as big as circus rings. The largest one has a diameter of seventy-five feet, the smaller of not less than sixty feet. From the inside and outside circumferences of the large corona hang one hundred and two 2,000 candle power lamps. The smaller carry seventy-eight arc lamps each, making a total of four hundred and fourteen arc lamps, shedding a radiance of 828,000 candle power, from a height of one hundred and forty feet from the floor and sixty feet from the trusses. Of the many plans proposed, that most favored was one for lamp-post lighting for which 1,200 lamps were conceded. The space between the two rings of the corona is provided with a platform from which the lamps may be trimmed.

The engineering details regarding these coronas and the additional lighting of this building, with comparisons between it and other large interiors, may be found in the *Electrical Engineer* of March 29, 1893.

Digitized by Google

Inseparable from the great question of arc lighting proper is that of search lights. Of these, the most noteworthy at present are those of the battle-ship, and those standing at the four corners of the roof of the Manufactures Building, the most notable being a sixty-inch projector of special design of German manufacture, which is claimed to be the largest in the world. It would appear, however, that the honors of search light manufacture are not to be entirely captured abroad. It is expected that an American company will send to the Exposition a projector somewhat larger than that just mentioned, which, it is claimed, will far surpass the foreign one, both in effective illumination and perfection of workmanship.

Incandescent Lighting of Interiors.

Several of the large Exposition buildings are entirely lighted by incandescent lights. Among those worthy of special notice is the Palace of Arts with—main building, 10,852; east annex, 3,422; west annex, 3,500; total, 17,774 lights, which is perhaps the largest amount of incandescent light in any one building in the world.

The Administration Building forms an interesting subject for electric light study, the interior of the dome of this building being brilliantly and evenly illuminated by incandescent light. It is the only dome of magnitude in the world in which the light has been uniformly and satisfactorily diffused. Large domes heretofore have been simply illuminated by straggling lights. This dome is one hundred and twenty feet in diameter, or thirty feet in excess of that of the Capitol at Washington, and larger than the dome of St. Paul's at London, and in the successful solution of the question of its lighting, careful study and much difficulty was encountered. The original intention was to suspend from the dome an immense corona or electrolier. This was shown to be impracticable, the large diameter of the hanging structure, which the immense space would require, precluding the safe employment of a fixture supported by a central shaft. Fortunately, the gallery within the dome permitted the arrangement in its inner edge of a circle of lights, whereby the same effect as a corona was produced, but upon a very much larger scale than would have been possible under the original proposition. The result of this is most satisfactory. Aside from the effect produced, the lighting is economical, eight hundred lights only being used.

In many of the other buildings there are special arrangements for most effectively utilizing the incandescent electric lights—the large spaces requiring absolute consideration of rigid economy, thereby necessitating careful distribution, which may be suggestive in other applications.

The use of incandescent lights in the illumination of the exteriors of buildings is a source of especial attraction and remark. It is considered by a great French authority to transcend everything heretofore attempted. But if the present effect shown is marvelous, what would have been the result if the original plan and recommendations had been carried out?

There are many features of decorative lighting of various kinds in Electricity Building, among which the central tower forms a prominent

Digitized by Google

object. Noteworthy, though incomplete, are the decorative features of the Grand Basin, the exterior of the Administration Building, and other buildings surrounding the basin.

It was originally intended that there should be a further accentuation of the lines of the Grand Basin and canals by the use of incandescent lights along the borders, thereby producing the pleasing effects due to the reflection of the myriads of star-like points in the dark waters. In, and above the waters of the Grand Basin, elaborate light effects were intended to be operated. The borders of the flower beds were to be outlined with several thousand incandescent lamps, embellished with shades of fanciful designs. This work was nearly completed when it was abandoned to meet the caprices of the artists, who could not decide as to its desirability, although a similar arrangement at Paris, on a smaller scale, was highly appreciated by visitors.

It was further intended that the notable constructive features of the principal buildings surrounding the Grand Basin should be more comprehensively outlined, and that similar treatment should extend to appropriate groups of figures which should be provided to symbolize the uses for which the buildings were erected.

The idea of these additional features, however, has not been carried into effect, thereby lessening materially the completeness and effectiveness of the electrical illumination considered in its entirety.

The Electric Luminous Fountains have a special interest, for they are built on a larger scale than ever before attempted. They are not as elaborate as they would have been had the first designs been carried out as to their location, which was originally intended to have been in the center of the Grand Basin. The selection of the sites on which the Fountains were finally built was made necessary by the lack of decision in executing the contract, the latter not being closed until December last.

The electric fountains stand within basins 60 feet in diameter. In the construction of these fountains many natural obstacles were encountered. Excavations had to be made in the swampy ground, and a water-tight chamber built eight or nine feet below the lake water level. The projected use of an iron caisson was abandoned in the face of the many difficulties which presented themselves, and a special construction was adopted. Piles were sunk into the ground, and upon the shorter ones a floor of interlacing beams was laid, upon which concrete was run to form the floor proper of the chamber. Longer piles serve as columns for the support of the wooden water deck. By this means an equal distribution of pressure from below and around was secured. Entrance to the chamber is gained by a water-tight passage.

The central, or MacMonnies Fountain, is in reality a cascade of falling water. This fountain was to have been elaborately treated electrically, and plans were prepared for that purpose. Failure to secure prompt decision resulted in the abandonment of the idea.

The Electric Fountains are purely geyser-like in their action. They were designed to be operated by a water pressure of 100 pounds to secure the most effective results.

Digitized by Google

Owing to oversight of the Exposition in not having properly anticipated the requirements necessary to secure this pressure, a state of affairs over which the contractor of the fountains had no control, and also failure to provide a proper and sufficient supply of water, these fountains cannot demonstrate their inherent capabilities. They were constructed to have an intercept of seventy feet for the outer and inner stream; also with very much larger nozzles than those that have been substituted. The limitations imposed, due to the insufficiency of the water supply, diminished the maximum effects that would otherwise have been obtained. The Paris fountain of 1889, had 17 orifices, while each of the Chicago fountains had 19 orifices, or a total of 38. The capacity of the "projectors" in the Chicago fountains is one-third greater than any heretofore built for a similar purpose. The conclusion is obvious, that properly operated, and a sufficiency of water, their excellence would be in proportion to their dimensions. The total consumption called for is at the rate of 30,829,600 gallons per 24 hours. In each fountain there are twelve wheatsheaf rings with 1,560 jets, seven little Geyser rings with 49 jets, one curtain ring with 70 jets, eighteen jets for small geysers and parabolas, twelve jets called "pulverizers" on the outer edge, and one large jet for the Great Geyser. These jets, under the conditions laid down for their operation by the designer, would call into requisition the entire capacity of the great forty million gallon pumping station set up by the Worthington Company on the Exposition grounds.

The great Geyser occupies the center of each fountain and is designed to throw a jet of water at least 150 feet high. It is encircled by a ring of jets, which form a curtain, and by six sets of small geysers. In the outermost circle are set the parabolas, the "pulverizers," and the wheatsheaves. Each basin has 19 composite groups.

The lighting is effected by 19 arc lamps of 80 amperes each in each subterranean chamber. They are of a type specially designed for this work, and are estimated to give a beam of light of 250,000 candle power each. They are operated two in series, and are automatic in their action, keeping the arc constantly in the center of the 28 inch silvered reflector. The wiring is on the three wire system, at 240 volts pressure. A switchboard is placed near the entrance to each chamber, carrying a voltmeter and ammeter, as well as a regulating rheostat for each lamp circuit, with the necessary switches. The fuse boxes are placed behind the board. The valve mechanism is in close proximity to the switch-board, so that the manipulation of both electrical and hydraulic apparatus can be effected almost by one operator.

The system of color screens is novel. Near the ceiling of the chamber is a shafting and gearing mechanism, which can be swiftly operated from three handwheels under control of one man. Each color screen is mounted upon an upright revolving shaft, and is divided into six compartments, each of colored glass—white, ruby, blue, green, yellow and sea-green. The glass in each compartment is divided into strips. The gearing is so arranged that almost any combination of color can be obtained.

The operation of the fountains is controlled from a signalling station on

Digitized by Google

the northeast tower of Machinery Hall. The signalling apparatus is comprehensive, enabling the director to see in a moment exactly how the fountains are operated.

Further particulars as to engineering details can be obtained in the *Electrical Engineer* of May 3d, 1893.

The fifty electric launches, owned by the Electric Launch & Navigation Company of New York, with the apparatus necessary to charge their batteries, will be found to be a very interesting feature of the Exposition, and one on pleasure bent cannot fail to enjoy a trip on one of these boats through the canals and lagoons traversed by them.

During the construction of the Exposition Buildings, electricity as a motive power was very extensively employed. Motors were utilized to run saw-mills, planing machines, pipe-bending and cutting machines. Almost every hoist used in raising the large iron beams and girders into their lofty positions was operated by a motor. Indeed, electrical power was utilized as it had never been before. Electric motors are still extensively used in the service of the Exposition in the driving of line shafting, and for many other purposes.

The knotty problem of the rapid transportation of visitors to the World's Fair, from point to point within the grounds, has been very successfully met by the Intramural Elevated Railway, constructed and operated by the Columbian Intramural Railroad. The track is double and is built upon an elevated wooden structure. While the entire road is but a temporary installation, its electric details have been carried out with a perfection which permanent roads might envy.

The actual length of the line is 14,800 feet of double track, and 1,900 feet of single track. At either end is a loop. There are ten stations, and the line passes by most of the principal buildings. The rolling stock of the road consists of fifteen trains of three trailers and a motor car, and three extra motor cars, each car being 50 feet long. Each motor car is equipped with four 160 horse power motors, on each axle. They are single reduction, weighing about 4,000 pounds each, and are geared to a speed of 35 miles an hour. Current is taken from the conductors by means of sliding shoe contacts hung on link attachments, which ensure excellent and even contact. There are four trolleys to each motor car—two on each side. The motors are controlled from a series parallel controller at the front end of the car, and they are so connected that in starting they are all in series; the next step connects them in series of two each, in parallel; the third step throws them all in parallel. This gives the maximum torque in starting.

The cars are commodious and well lighted, having the seats facing each other. The doors are all controlled by a lever at the end of the car, so that they may all be opened or closed at once by the conductor. The trains are all provided with air brakes. The current is carried from the generators in the power house, near the Forestry Building, along rails laid parallel to the tracks and raised about twelve inches above the cross-ties. Parallel to these conductor-rails is another rail also raised on blocks, which serves as a feeder, and runs about three-fifths of the distance from the power house, contact being made with the conductors at every rail length.

Digitized by Google

The power-house contains the most perfectly equipped station in the world. The boiler room contains ten boilers, each of 300 horse power, fired by oil. The engine room contains a Reynolds-Corliss engine, of E. P. Allis make, coupled to a 500 k. w. multipolar generator, a Lake Erie vertical engine coupled to a 750 k. w. generator, a McIntosh & Seymour engine coupled to a 200 k. w. generator, and a Greene engine belted to a 500 k. w. generator.

In the center is located the great 2,000 horse power cross-compound Reynolds-Corliss engine, built by E. P. Allis Company, driving the 1,500 k. w. multipolar, the largest generator ever constructed. This dynamo is so large, so massive, that it was found necessary to ship the parts separately to the Exposition and assemble them there. Some idea of the size of this gigantic dynamo may be gathered from the following table of weights and measures:

Field Magnet, complete.	80,000 lbs.
Armature...........................	73,600 "
Commutator.........	12,400 "
Total Weight of Dynamo.................	180,000 "
Diameter of Armature...................	10 ft. 6 in.
Face of Armature.......................	36¾ inches.
Diameter of Flywheel	24 feet.
Face of Flywheel.......................	24 inches.
Depth of Rim of Flywheel...............	20 inches.
Diameter of Commutator.................	7 ft. 6 in.

The fields are compound wound, and the twelve pole pieces are each bolted to the magnet frame by four bolts. The armature is built up of 17,200 pieces of sheet iron, slotted to receive the copper bar winding. Each coil consists of two turns, each consisting of two copper strips in multiple, carefully insulated by mica, and then set in the armature slot, itself lined with mica. The entire electric equipment of the road was effected by the General Electric Company, to whom I am indebted for the above information.

The fly-wheel of the engine weighs no less than eighty-five tons, and it and the armature are revolved on a shaft two feet in diameter, weighing fifty-five tons. The crank discs of the engine are each seven feet four inches in diameter.

As a model elevated electric railroad the Intramural merits the attention of every practical railroad man.

There are many electrical features worthy of special notice, among them the complete naval equipment on board the battleship Illinois; sliding sidewalk on the main pier, and innumerable special apparatus as exhibited in Electricity Building. To review them in detail would be beyond the scope of this paper. When the Exposition shall have been closed and the results achieved can be judged more broadly and with a fuller intelligence than is now possible, I hope to avail myself of the time to treat this subject more

Digitized by Google

thoroughly. There is sufficient in this Exposition of electrical material to merit the most careful observation and study.

On motion of Mr. Gilbert, the thanks of the Association was tendered Mr. Stieringer for the care in compiling his paper, and the able manner in which the subject was presented.

Capt. Brophy's Address.

THE PRESIDENT: It gives us pleasure to have with us Capt. William Brophy, so long and intimately connected with fire insurance matters and the matter of switchboards, and we will now hear from him as to what his experience has been in this line for the past eleven months.

CAPT. BROPHY: *Mr. Chairman and Gentlemen.* One year ago, I believe, I outlined roughly a plan for the insurance of Electric Light Stations, and it was then that ten of the Associated Industrial Mutual Insurance Companies of New England had decided to take up this class of insurance. They did not exact the same conditions from electric light plants as they did on manufacturing risks, from the fact that men were supposed to be employed the entire time in these establishments, and reliance was placed on the presence of the men with the proper appliances at hand for them to use in case an emergency arose.

Now, the experience of the last eleven months is this: The amount lost exceeds the premium received by over fifty per cent. Two of our best risks were totally, or nearly totally destroyed—one at Buffalo and the other in Elizabeth, N. J.; the one in Buffalo last March causing the companies a loss of about $94,000. The last one was in Elizabeth, N. J., a modern station, built upon the most approved plans, and the main building was totally destroyed, causing a loss to the companies of $125,000. In this connection, however, I might say that, while the loss to the insurance companies was complete, it was not a total loss to the owners.

This experience goes to show, therefore, that covering an electric light station with a blanket policy for less than its value is not a paying investment to the companies.

I might say here, that I have experienced a great deal of difficulty in presenting the electric light feature to many of the insurance companies, for the reason that the directors are manufacturers and know nothing of electricity and the electric light business. They could view with perfect equanimity the loss of one of the greatest cotton mills and pay it without flinching, but when a fire occurs in an electric light station, they hold their hands up in holy horror and say there must be something mysterious in the business; that there must be something inherent therein that makes these risks supremely hazardous, and that this line of business cannot be handled with profit. Furthermore, the inspectors are only experienced in manufacturing risks, and know very little about the requirements for an electric light

Digitized by Google

station, and the business has been looked upon with distrust from month to month by the different companies. Now these different companies, after the destruction of the Elizabeth station, were given the choice of withdrawing from the compact, and after that experience we did cease to write any more policies on electric light plants. Thus, the bond of compact entered into a year ago no longer exists. There are certain of us, though, who do not believe that the electric light insurance is not profitable, or that it could not be made so, and, with that end in view, we propose to carry on the business in a different way. Instead of dividing it up between ten companies, we propose to reorganize one already in existence, which will carry these lines.

I do not propose at this time to treat the subject of insurance in general, but as it applies to your own particular line of business.

I need not detail to you, gentlemen, the necessary steps to pursue to organize an electric lighting company, and the serious difficulties that often present themselves to those who attempt to secure the necessary capital for such enterprises, to say nothing of the task of paying a satisfactory dividend on the investment when secured. I am quite well aware that certain honorable legislators have labored long and hard to enable towns and cities to enter into the business of municipal lighting, and thus relieve themselves of the unjust tax they would have people believe is being levied on them, necessary to pay the enormous (?) dividends they claim you receive, many of them knowing that a fraction of the same would be very acceptable to most of you.

But while honorable Mayors will descend to the level of raising false issues of this kind to enable them to reach the goal of their political ambition, while members of the great and general court will pass acts and resolves to enable cities and towns to provide nurseries, misnamed electric lighting plants, in which to spawn the followers of cheap ward politicians, and at the same time provide a bottomless pit into which a large share of the town and municipal taxes can be thrown without exciting the suspicions of the dear people who pay them, so long will you be held up as bloated capitalists and oppressors of the masses.

Reliable insurance against losses by fire is as necessary as capital, and, in fact, it is one of the prime factors in securing it; for very few capitalists would be willing to advance funds unless the burnable portion of the property was well covered by insurance, placed in companies of unquestionable standing.

As this is as necessary to any company, and must be obtained by nearly all, what is the best course to pursue to secure the best and at the least cost, and why it is so difficult to do so, are questions I propose to answer to the best of my ability; and I hope my conclusions will commend themselves to your better judgment, as they are the result of daily experience in and observation of electric lighting plants, and consultations with those engaged in the electric lighting business, many of whom are paying dearly for past mistakes due to faulty construction, undesirable neighbors, little or no protection of their own or that usually provided by municipal authorities.

Digitized by Google

In the early days of the electric lighting business, many of those who planned or projected an electric lighting plant seemed to totally disregard all the well-known principles of mechanical engineering, while the architectural designs most readily adopted were those that were least adapted to economy of labor or space, and most likely to invite incipient fires and ultimate total destruction; while the idea of providing a single appliance for promptly extinguishing fires was never thought of.

In most cases then, and too many at the present time, total reliance was placed in the tender care and forbearance of divine providence, and numerous insurance policies, written at an excessive rate of premium, and for small amounts, by reputable companies, who were willing to gamble in this way, or written at low rates by that species of animal, the "wildcat" insurance company, who, like their feline namesakes, take all they can get and give nothing in return, and evade pursuit quite as readily when an attempt is made to collect the sum named in their policies.

With the condition of things above described, it is not to be wondered at that fires have occurred with more or less frequency in this class of property, most of which might be ranked as extra-hazardous at first sight, while I regret to say a few which might be ranked fair to very good have been totally destroyed.

It need not be wondered at that wooden shells on light frames, sheathed with pine or white wood at sides and ceilings, leaving concealed spaces, with boilers poorly set, and iron smoke flues touching or dangerously near wood that is being slowly carbonized, rendering it still more inflammable; with iron stacks extending through floors, ceilings and roofs, without sufficient space intervening (a striking object lesson in the dangers attending this arrangement was given a short time since on the World's Fair grounds, when to the total destruction of the building was added a fearful loss of life); grease allowed to accumulate on wooden floors until they are completely saturated, rendering them fit food for the flames; with attic and basements filled with miscellaneous truck, much of which is useless, but the storage of which is hazardous, should burn, but the wonder is that they do not burn oftener. It is unfortunate that fairly good to excellent electric light stations should take fire and burn down or be badly damaged even while men are on duty therein. But it is exasperating to think that by slight changes in construction, additional fire protection, the exercise of more care or more knowledge of and experience in the use of the appliances provided, they might be prevented.

I will now take up in detail a few of the fires that have come under my observation, giving the causes and how they might have been prevented.

First comes the United States Station at Providence, R. I. This building was not originally built for the business of electric lighting, and a portion of it was occupied by other tenants. Dynamos and engines were on the same floor. This floor was cement, but oil had been allowed to accumulate thereon to such an extent that several barrels of sawdust were spread over its entire surface to absorb the grease and filth. You may smile and think that the man who did this should be sent to some institution for the

Digitized by Google

care of feeble-minded youth, but I fear there are those still engaged in the business who are as worthy objects of the fostering care of such an institution as he, if the condition of the property under their charge is an index of their mental capacity.

There were but two men on duty, one in the dynamo and the other in the boiler room. As might be expected in a station where such conditions could exist, discipline and order were unknown quantities, as was any sense of responsibility on the part of the employees, as the results will show. The man on duty trimmed the pilot lamp and did as he often had before, threw the hot carbons on the floor, not thinking for a moment of the oil-saturated sawdust. He then calmly sat down and enjoyed the sleep he should have secured when not on duty. The combination of hot carbons and oil-soaked sawdust soon resulted in a little blaze easily extinguished if seen in time, but the guardian of the room was oblivious to all his surroundings until the little blaze, fanned by the moving belts, became a roaring fire, the smoke from which entering his lungs finally awoke him, but in his half-dazed condition he was in no sense able to cope with the fire, or even make his escape. The fireman was cleaning out the ashpits and could not know what was going on in the dynamo room, but he either discovered the fire or was attracted by the cries of the other man, as it was afterward found that burning oil from one of the tin lubricators poured down over him, after he entered the dynamo room, causing his death some hours after. He never uttered a rational sentence after the accident, while the other man was found dead in the dynamo room.

This fire may be laid to the incompetency of the superintendent and the lack of responsibility induced by his example in the other employees.

I have given you the true cause of this fire, not the one given by the majority of a self-constituted committee of three, who made a so-called investigation, two of whom decided it was caused by an explosion of coal gas, and the third, a so-called electrician, who insisted that the room was so filled or charged by positive and negative electricity that discharges like lightning took place and caused this fire to spread with lightning-like rapidity.

From the actions of most of the insurance companies at the present time, it is fair to presume that most of them accept the conclusions of this quack as the true cause of all fires in electric light plants, and that it is beyond the power of mortal man to foresee or prevent them.

Next is the fire in the Edison Station at Brockton. This fire originated in one of the feeder equalizers, the resistance coils of which being enclosed in a wooden frame, they overheated and ignited the same and from there it communicated to the wooden roof. The cause of the spread of this fire was, as in the former case, due to the incompetency of the superintendent, resulting in such a lack of discipline that the man in charge of the dynamo room could go out and lean over the fence long enough to permit the fire to get far beyond his control before he discovered it, had he anything to control it with, well knowing that no watchful eye would be likely to discover his delinquency.

Next was the fire in the Edison Station at Head Place, Boston. This,

Digitized by Google

as many of you know, is a fire-proof building. The walls are brick, floors brick, resting on and between iron beams. The roof is wood resting on one of these floors, as it was originally intended to carry the building higher. The wooden roof is covered with tar and gravel. The bare brick walls of the dynamo room, not suiting the aesthetic tastes of the superintendent, he resorted to a practice very much in vogue at that time and covered both walls and ceiling with wood, also covering the feeder equalizers with the same material. A short circuit in one of the feeders resulted in overheating the coils of the equalizers, fire communicated to the wood, worked up behind the sheathing and ceiling and had gained such headway when discovered as to be beyond control of the men on duty, owing in a measure to lack of organization among them for such emergencies, as there was fire hose attached to standpipes in the room. The fire did not get beyond the dynamo room, and while the building was practically uninjured, the contents of this room were ruined.

This fire was due to the introduction of unnecessary and useless material into a fireproof building. Its rapid spread, when discovered, according to the story of the men, would tend to strengthen the theory of the Providence crank in the minds of the insurance men, while, in point of fact, its progress might not have been rapid from the start until it was discovered.

Then comes the fire at the station at Narragansett Pier. A conspicuous example of what a station should not be, this building is of wood, two stories high, with one story frame boiler house. The general style of the building is the same as that prevailing in seaside dwellings, with the usual filigree and gingerbread work. The lower story was sheathed at sides and ceiling. The fire was caused by the negligence of one of those superintendents who never can do to-day what can be done to-morrow or next day. In the angle formed by the boiler house and the main building a large heap of rubbish was allowed to accumulate, consisting of large quantities of oily waste, broken packing boxes, straw, empty oil barrels, etc. A spark from a passing locomotive on the railroad track nearby probably ignited this inflammable material one Sunday morning, when there was but one man present, and he in a bedroom. It communicated to the building, and, before it was discovered, attained such headway that before it was under control it totally destroyed the boiler room, and the roof and upper portion of the main building.

I visited this plant a short time before this fire, and pointed out the danger from this eyesore, but at that time the companies with which I was connected had no insurance on the plant, and my suggestions were advisory rather than mandatory. But, unfortunately, it was insured by them at the time of the fire, although I did not know it until then.

For protection a 2″ pipe was run about one thousand feet from the street main. This supplied the water for boilers. A 1½″ tee was put on the end of this pipe, and two 2½″ hose outlets attached thereto. A fine piece of hydraulic engineering you can all see. That such an arrangement proved very inadequate in time of need goes without saying, and with the delay in discovering the fire, giving the alarm, and the necessary delay in

Digitized by Google

getting the apparatus of a volunteer fire department to the scene, and in operation, the wonder is that the total destruction of the property did not result.

Next comes the burning of the station at St. George, Staten Island. The main building was of brick, one story high, containing high speed engines, dynamos, etc. A frame building, formerly used as club house, was purchased and moved up to the original building. The first floor of this contained the boilers and a large Corliss engine, while the second floor contained that undesirable adjunct—a workshop. Steps had been taken to equip this portion with automatic sprinklers, but they were not installed. The fire originated in this place. It was discovered by people on the street, and an attempt was made to extinguish it with hose on the premises, connected with the waterworks, but the water was shut off. Hose was then attached to the boiler pump, but the fire by that time had gained such headway that the capacity of this pump was not sufficient to cope with it. The result here was the total destruction of the building and contents.

The primary cause of the fire was poor construction, and the total loss due to inadequate protection, showing conclusively that one source of water supply is not sufficient in all cases for the proper protection of any property from destruction by fire.

Next in order comes one near home—the Ferdinand Street Station of the Boston Electric Light Company. The construction of this building in the main was good, but it had some objectionable features. The building was then, as now, three stories in height, brick walls, wooden floors, joist and rafter construction, flat roof, open stairways and elevator; but the crowning defect was the wooden sheathing on the sides and ceiling of the dynamo room, which gave the fire an opportunity to get in its work unobserved for no one knows how long. Small hose attached to standpipes, and supplied from the city mains were located on each floor, which ought to have been sufficient to control a small fire if promptly brought into use. Two men were supposed to be on duty in the dynamo room, which was situated on the second floor, but from the fact that the engineer on duty on the floor below saw the reflection of the light of the fire on the buildings on the opposite side of the street, sometime before he was made aware of its location, it would seem that they must have been in a state of somnolence, or were enhaling the bracing air of a cold, clear, winter night; possibly in the society of a fair or congenial companion. One of them rushed down into the engine room crying—shut down, the building is on fire. Instead of shutting down, he (the engineer), took the hose at the foot of the stairs, turned on the water, and attempted to ascend and attack the fire. But it gained such headway that he and his companion could not reach the head of the stairs, and, while one left the building, the other went to look after the boilers, leaving the engines to run until shut down by the fire department.

The cause of this fire, as at first given by the men supposed to be in the room, would seem to be electrical, as one of them at least thought it started at the ceiling near the switchboard; but, if that were true, it must have

Digitized by Google

made extraordinary progress to burn so fiercely at the stairway, some fifty feet from this point, in a few second's time. If this were so, the theories advanced by the before-mentioned crank, and by other well-meaning people, that the presence of ozone in a dynamo room is sufficient to account for the rapid spread of fire therein must be heeded. But just here comes in the hard but reliable rule of common sense, which prompts us to seek for the true cause. An examination of the premises showed conclusively, first, that the fire must have started near the head of the stairs, probably in a water-closet located there. A lighted match, after having done duty in igniting a cigar or tobacco in a pipe, thrown down among the waste paper that usually litters the floors of such places, the lighted stub of the cigar or hot ashes from the pipe, alighting in the same place, was more likely to be the true cause of this fire, and the possible and probable absence of the eye of a watchful attendant the cause of its spread, unless it caught between walls, floors, or ceiling, where it could not be discovered. The origin of this fire is somewhat shrouded in mystery, but the cause of its spread was no doubt due to the causes described above, and improper construction.

We next have the destruction of two stations at Buffalo, within a few months of each other. The first was meant to be nearly fireproof, but, as the business increased beyond the expectations of its owners, additions were made at different times that did not add to its safety. The dynamo and engine room was unduly crowded. This fire is supposed to have originated in a lightning arrester or a loose connection, both of which were located on the switchboard, the wires leading from which were covered with highly inflammable material, and over which the flames spread with great rapidity, and up into the second story, and the material stored there. Nothing was provided here for fire extinguishing purposes, and, of course, no effort made to stay the progress of the flames until the arrival of the fire department. Owing to the crowded condition, it was not a model of cleanliness, and the oil-soaked floors added fuel to the flames. The loss was heavy.

Then came the largest and best station owned by this company. This might be called an excellent risk, but as in many others had some defects not discernable to the unpracticed eye, but after the fire they were manifest to any casual observer.

First and worst was an unoccupied space under the floor of the dynamo room, access to which could be had at only one point, the average distance from the ground to under side of floor being about three feet. In this space were all the wires from dynamos to switchboard and tower. They were all lead covered, and but recently put in, and it is not probable that they were the cause of the fire. Masons were engaged on foundations for an additional engine, and that effective combination—a mason's tender match and pipe, and a quiet smoke in a secluded spot, safe from observation, was the probable cause of this fire. It occurred early in the evening when all the men were on duty, and was manifest to the sense of smell for some time before it was discovered. A trap in the floor being raised, the flame rolled up from beneath; and, although, hose and playpipes were located at several points

Digitized by Google

in the room, and connected to a powerful steam pump, no effort was made to use them. The fire under these circumstances made rapid progress, and the roof being supported on light timbers, strengthened by iron trusses, which quickly expanded, letting the whole down on the machinery, caused a total loss thereon.

This space under the floor was a fatal defect, and a fire in the same very difficult to handle, even by trained fire departments. The fire apparatus was of little use, as the men were not organized or trained in its use, showing conclusively the necessity for fire drills when such apparatus is provided.

The last, and the one that has had the effect of demoralizing insurance companies and rates on this class of property, is the fire at, and total destruction of, the station of Suburban Electric Light Company, at Elizabeth, N. J.

This was what might be called a model plant, even from an insurance point of view, and was kept in an excellent condition of cleanliness and order. It was built of brick, two stories high, mill constructed, with flat roof. The boiler-house, separated by a solid brick wall, extending above the roof. The lower story or basement contained the foundation for the engines and shafting. There were also a few supplies, but very few that could be called inflammable. Power was furnished by two large Corliss engines, the fly wheels of which extended through the floor, and into this basement. Within ten feet of one of these, set on end, was a barrel of oil on a wooden box.

Sometime after eleven o'clock a strong smell of burning oil pervaded the dynamo room. The two men on duty proceeded at once to examine all the bearings, which were numerous, and this consumed considerable time. No hot bearings being found, they proceeded to the basement and found flames streaming out of the barrel. They at once returned to the dynamo room and attempted to shut down, but the action of the fly wheel carried the flames up, so that it was impossible to reach the throttle. There was nothing in the form of fire pumps, hose connection and hose on the premises, and a fire once under headway had full sway. The loss on the main building and contents was nearly total to the owners, and total to the insurance companies.

I have given you these rather minute details for the purpose of calling your attention to the probable causes of the several fires, and how they might have been prevented.

With the present feeling prevailing among insurance companies, combines and associations, I fear the time is distant when insurance can be secured on as favorable terms on property of this class as on others equally as hazardous.

In all fairness I must say that the blame for this state of affairs does not rest wholly with the above named associations. A good share of it must be borne by some of those engaged in the electric lighting business. To be frank with you, gentlemen, I must say that but very few of the thousands of electric light men have any conception of the value of excellent construction or adequate protection of the different grades of electric stations.

Digitized by Google

Let me picture to you the model fireproof building, those of slow burning construction, and how to improve existing plants that cannot be classed with either.

The owners of a building with brick walls and floors, with metal or other fire proof roof; iron window frames and sash ; standing metal doors ; no oils of any kind, except what is necessary for daily use; and no store-room or workshop contained therein ; unexposed by other building ; boilers if contained in the same building, to be absolutely cut off by a solid brick wall; the necessary openings protected by standard fire doors; boilers well and safely set, with ample space from floor to roof, need have little fear of its destruction by fire, or experience much difficulty in securing insurance and at low rates.

A station, built of brick, one or two stories high, with brick floors and flat roof, constructed of three inch plank, tongued and grooved, covered with tar and gravel, and the whole resting on wood or iron trusses, or square timbers ; and in every other respect like the one before described, is nearly as good, and ought to rate nearly as low.

Next, a brick building with heavy three or four inch plank ; floors with a top covering of hard wood, the whole resting on heavy square timbers ; roof same as last type; boiler house same with exception of roof; boiler room, in all cases, to be cut off by fire wall as before described; window casings and frames of wood; doors the same, but where exposed by other buildings, more particularly those considered hazardous, windows should be provided with standard fire shutters. In all cases where buildings are more than one story high, stairways should be enclosed in brick and be constructed of iron with self-closing standard fire doors, in a fire-proof building, such as first described, and enclosed in heavy plank in the two latter types. All weight-bearing iron supports, such as columns and posts, should be covered with non-conducting material, where much inflammable material is stored or kept.

One of these three types of buildings is the only one that should be built from this time on. It is assumed that no inside finish, such as lath and plaster or wood sheathings, leaving concealed spaces, is to enter into the construction of these buildings.

I have thus far described only the best types of electric light stations. What can be done, may be asked, to improve the vast number that are in existence, many of which cannot approach these in point of excellence?

My answer is that the very poorest class can be improved and made very much safer. First, take the brick stations, with pitched, hip, flat or mansard roof, with blind attic underneath. Rip this out at once; next, sheathing on the undersides of floor joist or rafters, rip it off. The same can be said of sheathing at the sides, if a hollow space is under it. The bare brick walls and enclosing boards of roof are the best finish. If a wood partition is all that separates boiler and dynamo room, pull it down, and build it of brick extending three feet above the roof. If the roof or ceiling of your boiler room is too low, raise it up or build it of metal; and if this cannot be done, equip it with automatic sprinklers. If your stack is of iron,

Digitized by Google

have it well protected where passing through wood floors and roof. A basement, second or third floor or attic, when used for supplies or general storage add greatly to the fire hazard and insurance rates, and should be banished from all stations when possible. Workshops ditto, or they should be equipped with automatic sprinklers. A basement or portion of first story containing lines of shafting seldom visited by any one, and invariably left alone during the night run, should be sprinkled, for hot boxes alone have caused the loss of millions of manufacturing property.

In point of fact, many defects in construction, which must add to the fire hazard and increased rates of insurance, can be remedied by the introduction of this reliable device. A never failing supply of water should be furnished to make them effective at all times.

In addition to the sprinkler system, outside hydrants should be set, the number and location of which should be governed by the size of the building, the nature and location of the exposures. They, like the sprinklers, should have a never failing supply of water, either from public waterworks or steam pump on the premises. A sufficient amount of hose, playpipes, etc., should be provided and ready for use at all times where a city fire department is not accessible. In addition to this, standpipes and hose should be provided in sufficient number in the interior of the buildings.

I have, thus far, only indicated the points where, in my judgment, it is imperatively necessary to install automatic sprinklers; but I believe those engaged in the electric business will never enjoy that immunity from loss by fire, or the abnormally low rates of insurance enjoyed by the manufacturers insured in the Factory Mutuals, until they follow in their footsteps, by building their stations in the best possible manner, and equipping them with the best known devices for protection against fire.

Each of the manufacturing establishments insured in the New England Mutuals is so equipped as to be independent of local fire departments for protection against fire. As a result the average cost to them for insurance is from ¼ to ⅓ of 1%.

One year ago ten of these companies commenced to write insurance on electric light and electric railway property. Owing to the fact that many of these establishments operate continuously, the same degree of protection was not called for as in the case of all other risks insured by them. Small hose on each floor with an abundance of water pails kept full of water, in some portions of the building; outside hydrants and hose when an efficient fire department was not available; general order and cleanliness insisted on, and unless the construction was not up to a certain medium standard, the risk was declined. In less than eleven months the losses sustained exceeded the premiums received by more than 50%, showing conclusively that reliance on apparatus of this kind, in the hands of the men employed, to cope successfully with fires, is like leaning on a broken reed, and worse than nothing.

I will give you one notable instance of the utter demoralization of employees. In the dynamo room of the Elk Street Station of the Buffalo General Electric Company were six outlets for hose, with hose and pipes

Digitized by Google

on swinging racks, ready for instant use. The fire occurred early in the evening, when the largest number of men was on duty, yet not one of these lines of hose was disturbed, and no attempt made to use them.

The last eleven months experience has demonstrated to these companies that the business of insuring electric light property at the same, and, in fact, less average rate than that charged for standard manufacturing property, is, in the first place, not profitable, in the next, unjust to the owners of the latter. For if they are to continue to pay to the former sixty to ninety per cent. dividends, it must be taken from the profits derived from the business of the latter.

Perhaps it would have been better had the companies continued to insure those risks that were equal in construction and equipment to standard manufacturing risks, but they are so few that they are hardly worth considering.

Owing to this action of these companies, electric property is now practically placed on the prohibited list, and high insurance rates must prevail. For this, gentlemen, you have the remedy in your own hands, if you will only apply it.

More than sixty years ago it was impossible for those engaged in the manufacture of cotton, woolen and other textile goods to secure insurance against losses by fire at rates that they could afford to pay, so that the owners of such properties could not rely on the policy of insurance to reimburse them in whole or in part in case of fire.

For this reason they were driven to first improve their property, so as to reduce the probability of destruction by fire, and next to provide the best devices for quickly extinguishing the same that could be procured at that time; and, where necessary, organized their employees into efficient fire companies, as well trained in this particular duty as any other. The next move was to mutually aid each other in case of actual loss by fire, by organizing the first of the New England Manufacturer's Mutual Insurance Companies. The officers and directors were owners or managers of some one of the factories insured, and were thus familiar with this particular kind of property, knew where the fire hazards existed, and knew best how to reduce the same, where possible. Each policy holder became a member of the company, and had a voice in its management, through the Board of Directors.

In addition to the then existing high rate of premium paid in cash, they obligated themselves to pay five times that amount as a contingent liability in case the cash premiums were not sufficient to pay all losses that might occur, and other necessary expenses.

So successful was this pioneer in mutual fire insurance, that there are now twenty-three such companies in successful operation, and they have over $650,000,000 at risk. The average net cost of this insurance on property, that at one time was on the prohibited list, is about three-tenths of one per cent. From the time of the organization of the first company to the present, they have never failed to return a portion of the premium in the form of a cash dividend after they once began; have never made an assess-

Digitized by Google

ment on their policy holders, thus showing that the contingent liability exists in name only.

With this example before them, why cannot those engaged in the electric business adopt the same plan and carry it to a successful issue?

The Industrial Mutual Insurance Company, in connection with nine others, has been writing insurance on electric property since August, 1892. Owing to the losses sustained by the burning of the stations of the Buffalo General Electric Company and the Suburban Electric Light Company of Elizabeth, N. J., and to the fact that the Directors are manufacturers and unacquainted with the business of electric lighting and electric railways, they have decided to discontinue writing insurance of this kind. The action of these companies would have been quite different, no doubt, had the electric interests been represented on the different Boards of Directors.

The Industrial Mutual Insurance Company proposes to continue this business alone, providing insurance to the amount of $50,000,000 can be secured, to be written at *one time*. The plan has been submitted to the Managers of the General Electric Company, and many others prominent in electric light business, and has been heartily endorsed by them. Insurance already applied for, towards the $50,000,000 called for, amounts to nearly $20,000,000.

When the amount ($50,000,000) is secured, policies will be written, when the company will have ample means with which to meet any losses that may occur, as follows:

It will have cash assets, $594,058; its contingent liability, $2,800,621; its total security will be $3,394,679. Its receipts from interest will be over $22,000, which will pay its expenses. It will have $56,244,392 at risk.

It is the purpose of the company to secure all the desirable electric property it can, which will increase its dividends and reduce the proportionate expenses, and at the same time reduce the net cost of insurance.

I cannot in this paper give you, gentlemen, all the details of this plan of insurance you might require, and you might not remember them if I did; but any one of you desiring more detailed information on the subject can, by addressing me, receive the same promptly and fully. In connection with others, I have given this subject the most serious consideration for a long time, and I believe it to be the only way in which those engaged in the electric business can insure their property at cost.

On motion of Mr. Gilbert, the Association tendered their heartiest thanks to Capt. Brophy for his valuable paper, with request that he furnish copy of same to be incorporated in the Minutes.

Digitized by Google

Entertainment by the General Electric Company.

The chair here announced that Mr. E. J. Spencer, of the General Electric Company, had kindly offered to issue passes to any of the members who wished to see the working of the Electric Fountains, and also an invitation from the Ferris Wheel Company to entertain the Association as a body.

MR. GREENE: We shall also have at our disposal one or more electric launches, and we can meet shortly after 8 o'clock in the evening at the office of the General Electric Company in the Electricity Building, taking a trip around the Lagoon, after which we can visit the Ferris Wheel. This will also enable us to see the illumination of the grounds.

THE PRESIDENT: Then the order of the evening will be for the members to meet at the office of the General Electric Company at 8 o'clock, for the purpose of taking a trip on the launches, after which they will go to the Ferris Wheel.

Adjournment until 10 o'clock, Wednesday, August 9th, 1893.

The evening was delightfully spent by a large number of delegates in carrying out the programme thus arranged, in a ride on the "Ice Road," and a general inspection of other evening features of the Exposition.

Digitized by Google

SECOND SESSION.

The second session was called to order on Wednesday, August 9, at 10 A. M., the President in the chair.

Mr. Herrick's Paper.

THE PRESIDENT: We will now take pleasure in listening to a paper by Mr. Herrick on Central Station Switchboards.

MR. GREENE: Our idea in having Mr. Herrick come before the meeting at this time was to bring into prominence the developments in the switchboard and its adjuncts.

Mr. A. B. Herrick, of the Schenectady Works, then read the following paper, on "The Central Station Switchboard and its Adaptation to Different Modes of Distributing Potentials."

The Central Station Switchboard and its Adaptation to Different Modes of Distributing Potentials. By Albert B. Herrick.

The modern demand in a central station for an equal potential distribution has brought into use a number of systems whereby the potential at the feeder end may be varied and controlled with certainty. Moreover, this regulation must be obtained by the least possible expenditure of labor, and so reduce the switchboard attendants to a minimum. The general features that are indispensable are compactness and concentration. The idea for a large switchboard, for the largeness alone, is both expensive and clumsy. Every possible device that can be used with advantage to get the maximum kilowatts per foot of board should be adopted where its practicability seems to warrant it.

The idea of putting before you the various systems which have been exploited and operated by the large central stations, and also some of the newly proposed systems, which are now being designed, is to get your practical ideas, which will be brought out by discussion, in order that we may get up a standard panel for dynamo and feeder regulation, and for which the new central stations can be designed to adopt.

In the switchboard arrangement and design there are several different methods now used in the large incandescent plant, and the design of the

Digitized by Google

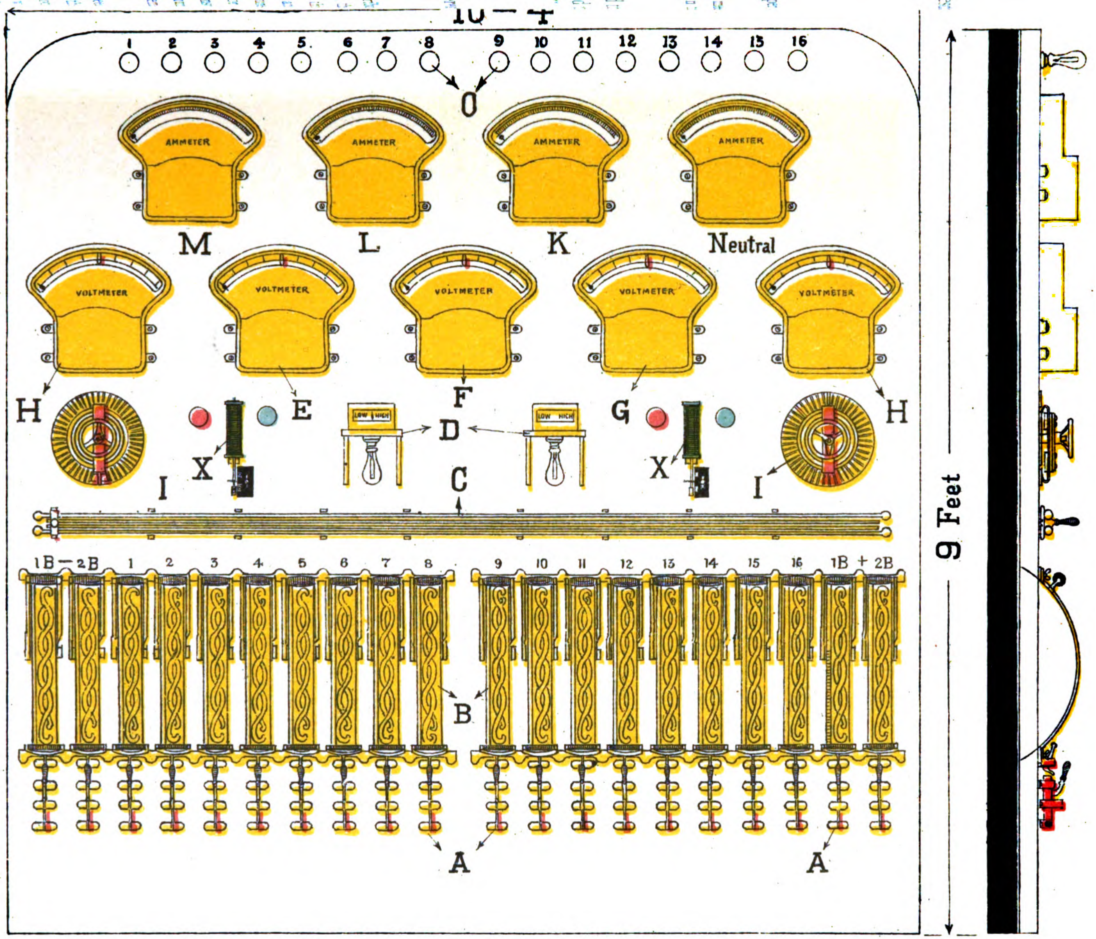
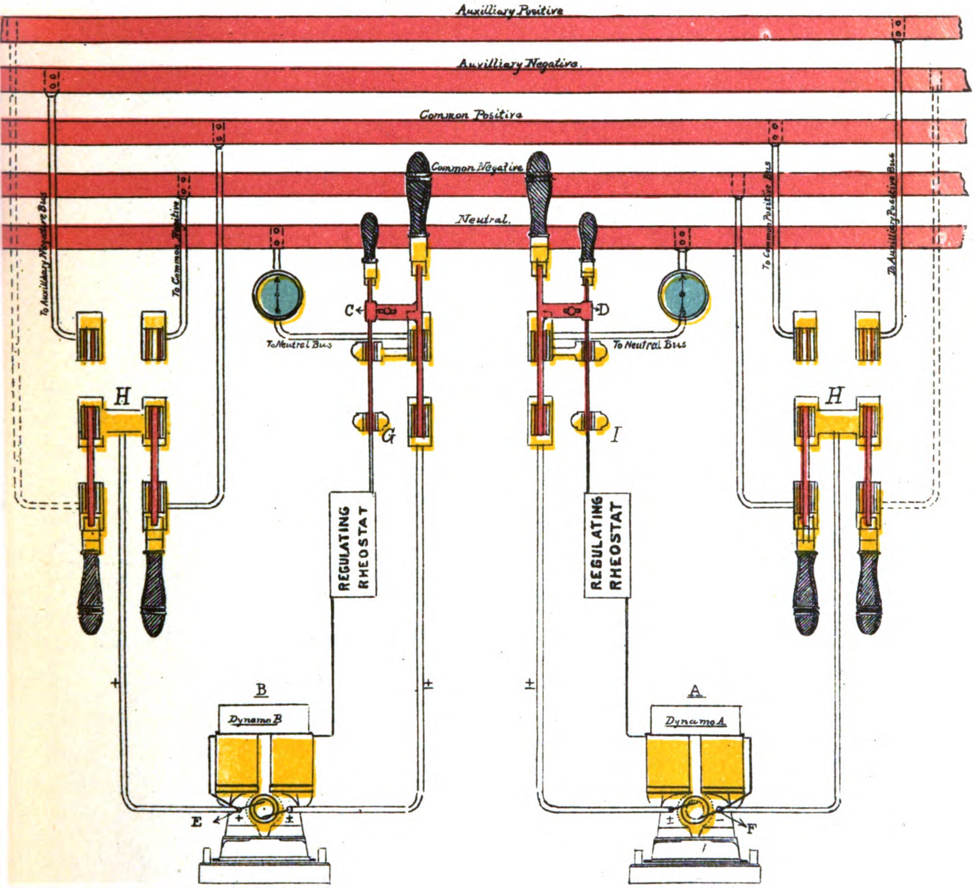


FIG 1

Digitized by Google

Digitized by Google



W. J. Donshea's Method of making Field Connections.

FIG. 2.

Digitized by Google

Digitized by Google

switchboard requires serious thought to give the best results for the outlay. The method used in regulating the dynamos and varying pressures on the different feeders will modify the designs and limit the concentration possible.

In dynamo regulation and control there are two methods that are in general use, one in which the dynamo switches, regulator, ammeter, voltmeter and field switch are mounted on one panel, and the other method, where the regulating devices, voltmetres and main ammeters are grouped together and the dynamo panel consists only of the ammeter and dynamo switches. This separates and puts in a small space the regulating devices which require the constant attention of the attendant. By this arrangement the pressure of a large output can be controlled by a single attendant, and the operation of the whole plant can be immediately under his eye. This form of regulating panel is shown in Fig. 1, where "AA" are the field switches and where the dynamo is excited from the bus. These have auxiliary contacts which throw first in circuit a bank of lamps when the field is opened. This extra resistance in the field has become necessary in the large multipolar dynamo as the induced current, on breaking the field, creates a high electro motive force. The field is materially weakened when the resistance of the lamps is thrown in series. The induced electro motive force is then greatly reduced in breaking the field, and the field coils are not subjected to the high potential tending to break down their insulation.

There are three methods of field excitation of dynamos, known as "Self-Exciting," "Bus Exciting" and "Separate Exciting." The advantages and disadvantages of these several methods are as follows :

In "Self-Exciting," the field terminals are connected to the brushes. The advantage of this method is that the field gradually dies away as the dynamo is slowed down, and when the dynamo has stopped the field has entirely disappeared, thus avoiding danger of a sudden discharge of the field, which would probably pierce the insulation of the field winding, or make a short circuit through the armature.

The disadvantages of this method are: 1st, The slowness with which the dynamo builds up its own field, the dynamo frequently running at full speed for a considerable length of time before it develops E. M. F. sufficient to be connected to the system. 2d, The possibility that the field may build up reversed. This may be caused by a sudden discharge of the field by short circuit, or even by proximity to another dynamo.

In "Bus Exciting" the fields are connected to the station mains or "busses"; this is the method generally used, and in the dynamo regulating board, shown in Fig. 1, this method is used. The advantages of this method are: 1st, That the field is instantly made and the dynamo can be connected into the system as soon as it is up to speed. 2d, The polarity of the field is always the same; it cannot be reversed. The disadvantage of this method is that the field is on, although the dynamo may be shut down, and it is necessary to discharge it through a bank of lamps or other resistance, by means of a field break switch. This method of discharge, although safe, might cause trouble should the bank of lamps be disconnected or otherwise out of order.

Digitized by Google

In "Separate Exciting," the field circuit of each dynamo, or of all the dynamos, are connected to a special dynamo or other current producing device. This method possesses the same advantages and disadvantages as the "Bus Exciting" method does. It has the additional disadvantage that the exciting dynamo or battery is small and therefore weak and unreliable. An accident to it would cause a loss of as many dynamos as were being charged from it. Not too much care can be exercised in the connection of the field circuit, reliability of regulator, abundant size of all field wires, and these should be stranded as an additional precaution. Mr. Donshea, Operating Electrician of the New York Illuminating Co., has invented a method of field excitation which combines all the advantages of both the "Self" and "Bus Exciting" methods. The connections are as follows:

One side of the field coil winding is connected to one of the brushes, E and F, see Fig. 2, and the other side of the winding is brought through the regulating resistance box to the blade of the field switches, "G I." This blade is pivotted on the same axis as the blade of the main dynamo switch on the regulating switchboard, but it is not connected electrically with it.

When the blade of the field switch, above referred to, is closed, it makes contact with clips connected with the neutral bus. The field circuit is then made from the neutral bus through the field switch, through the regulating resistance box, through the field coils and to the brush which is connected through switch "H" with the positive or negative bus, and the field is thus bus excited.

When the dynamo is up to pressure, as indicated by the dynamo galvanometer, the main dynamo switch is closed. On the blade of this switch are mounted clips which engage into the blade of the field break switch, and a pin, which is operated by a spring, drops into a hole or slot in the blade of the field switch and securely locks the blades of the two switches together at C and D. Thus, when the blade of the main dynamo switch is opened, it brings the blade of the field switch with it, the two remaining in electrical connection together. The field is thus "Self-Excited."

The engine is then closed down, the field gradually dying out; this being the special advantage of self-exciting the dynamos.

When the dynamo is wanted again, the pin which locks the blade of the field switch with the blade of the main dynamo switch is withdrawn and the field switch blade is brought up in contact with the clips connecting with the neutral bus. This instantly charges the field, and full field is had by the time the engine is up to speed; this being the special advantage of bus exciting the dynamos.

A further advantage of this method of exciting the field is, that as the field is connected on one side to the opposite pole to the neutral (that is, the positive or negative), it is charged from the common or auxiliary bus, depending on which bus the dynamo is connected to.

When running on the auxiliary bus, the higher pressure maintained there gives a greater working margin in the regulating resistance box than

Digitized by Google

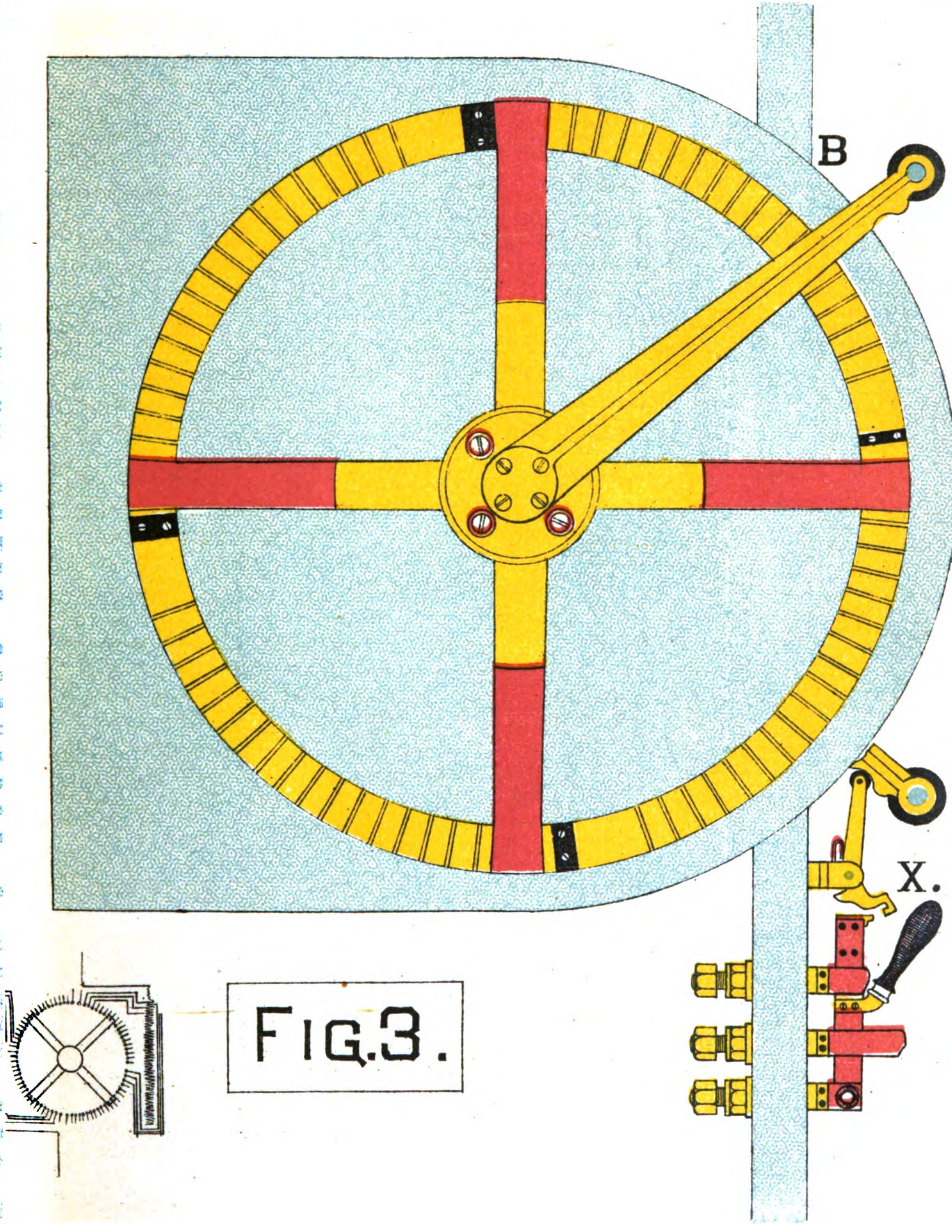


FIG.3.

Digitized by Google

Digitized by Google

LEFT DYNAMO PANEL

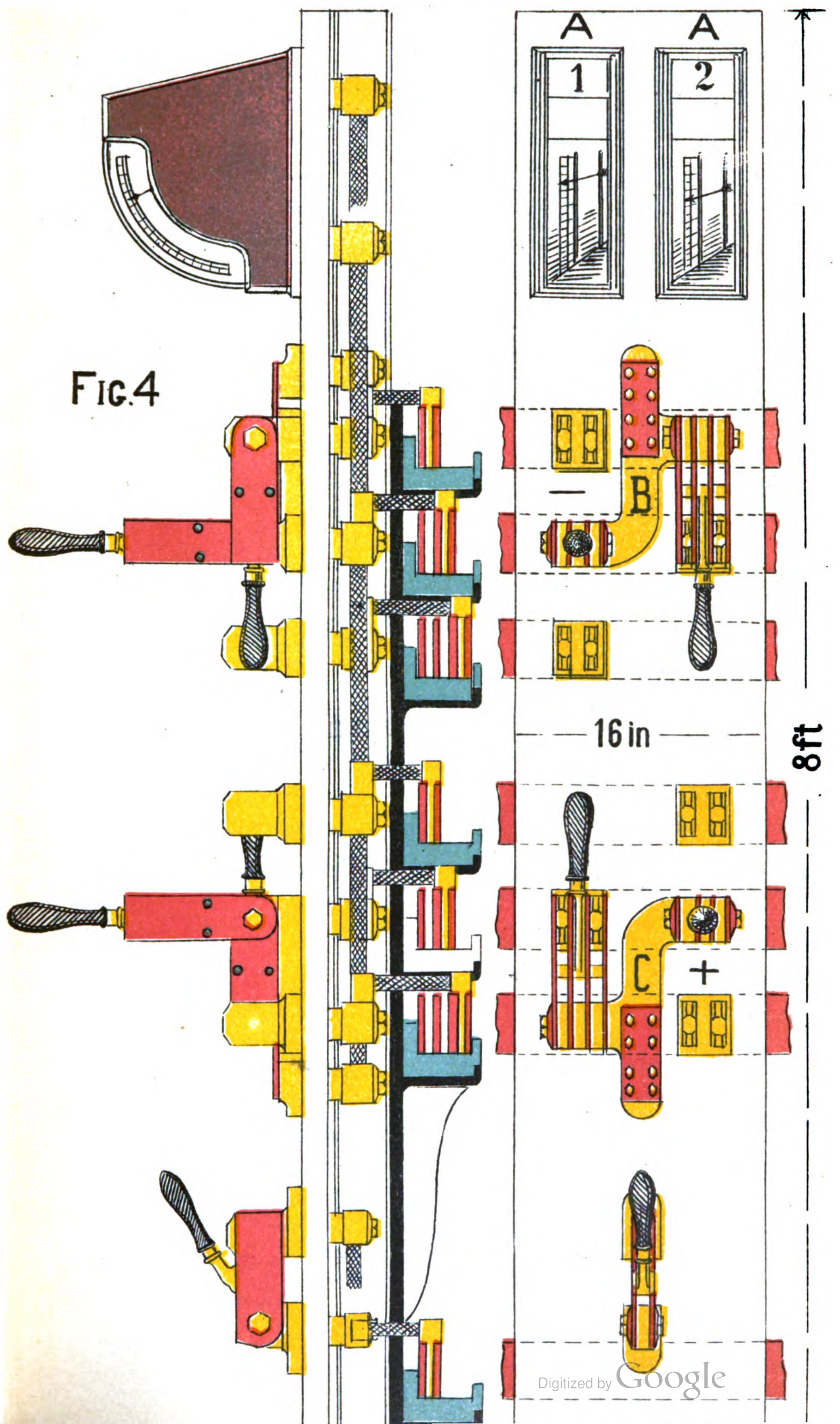


FIG. 4

Digitized by Google

Digitized by Google

FIG. 5.

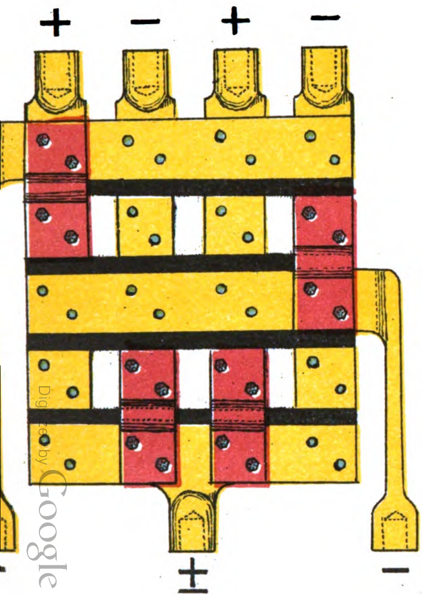


FIG. 6.

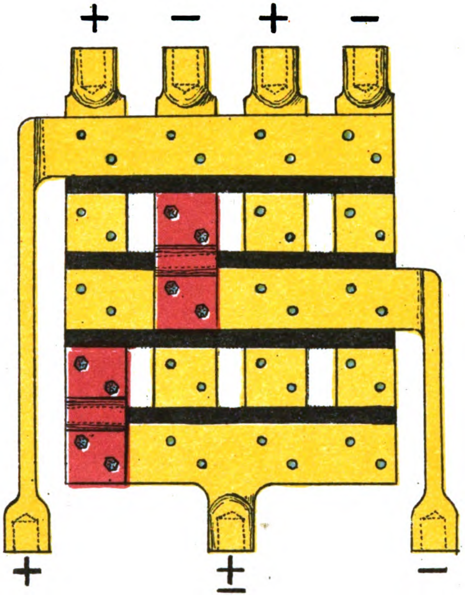
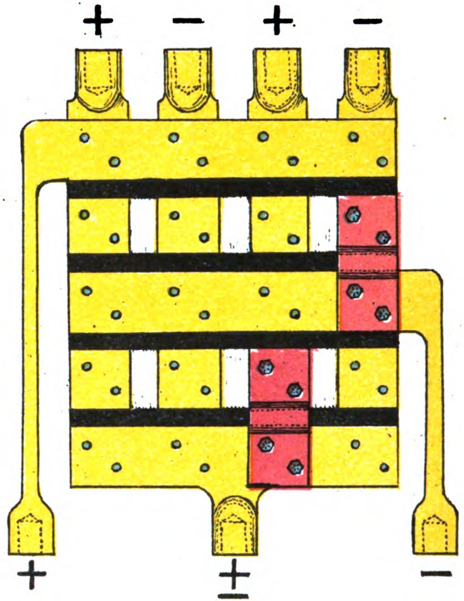


FIG 7.



Digitized by Google

Digitized by Google

is possible when the fields are charged from the common bus. A further advantage of this method is, it greatly simplifies the apparatus for throwing over the dynamo from one side of the system to the other in the three wire system. It is used to employ a throw-over head board switch on the dynamo, from which three cables are led to the switchboard, being connected to the positive, negative and neutral busses respectively. In the improved method, no head board change over switch is required, and but two cables from the dynamos to the switchboard need be run. One of these cables would be the permanent connection to the neutral bus through switch and ammeter, and the other would be connected to the change over switch connected to the positive and negative switches.

The regulator "B" (Fig. 3), is of a new construction, using a quadrant switch of the same general design as our stage regulator switch. The edge of the switch is presented to the face of the board and has eighty steps, and are connected in such a way that the full circuit is made by the contact arm when the lever is moved through 78 degrees. This is shown in full in Fig. 3 and diagram of connections. These regulator heads can be connected to their respective regular boxes by a flexible eighty wire cable, and these boxes can be located in any convenient place reasonably near the regulating board. The lever of the dynamo regulator switch also engages with an interlocking device X, which locks the field switch either in or out, when the regulator is in any other position than that of maximum resistance. This prevents the field switch from being pulled when the dynamo is carrying a load, and can only be pulled when the field is weakened and the dynamo taken off the bus. Directly above the regulating switches is a sliding contact "C" (Fig. 1), the whole length of the board, which has contacts above the corresponding pairs of regulators, and puts the dynamo galvanometers "D D" in circuit when the contact is slid above any desired pair of dynamos which is to be thrown in. E, F and G are volt meters for the different potentials used, this board being designed for three potentials. "H H" are the volt meters for taking the potentials for feeder ends, the pressure wires being all brought up the circular switches "I I" the pressure wires being attached to their terminals, and numbered to correspond to their respective feeders. The two switches might be geared together and could be revolved at a slow speed, traversing about fifteen pressure ends per minute, which would give the attendant time to note the different pressures on all the feeder ends every few minutes, both on the positive and negative sides. A relay could also be connected across these volt meter terminals set for a given difference of potential, and which would show red or blue lamps when the pressure of the feeder, over which contact arm is moving, is high or low. The three ammeters "M L K" are straight bar General Electric type, their total being the total output of the station. "O O O" are pilot lamps belonging to the respective dynamos, whose regulators are directly underneath them. The width of the board in this case is 10′ 4″ wide by 9″ high, with a maximum capacity of 20 200 K. W. dynamos. A 200 K W dynamo regulator requires a distance of 5½″ between centers, whereas 6½″ is abundant room for four 400 and 800 K. W. regula-

Digitized by Google

tors. Passing to the dynamo board (Fig. 4), which is equally divided on both sides of the regulating board, the positive and negative terminals of each pair of dynamos is brought through the two ammeters "A A," and then to the back of the switches B C. The ammeters are of peculiar form. The scale of this ammeter is raised perpendicular to its base, and it has the form of a quadrant of a truncated cone, so arranged that the adjacent meters do not interfere with the view of the full scale of the others, and all ammeter scales are plainly visible from the regulating board by being made right and left for the right and left side of the regulating board. The switches "B C," the upper being negative and lower being positive in this board, each pressure bus has a connection through the switchboard, and the dynamo switch is provided with two blades making connection with these lugs, so that the dynamo can be thrown on any bus bar, and this switch can also be used to tie any two busses together, which often becomes necessary when the load on the station is low, and a small proportion of the plant is necessary to carry all the load. The neutral switches are below the dynamo switches, and in this plant the dynamos are coupled together at the dynamo, and only one neutral is required by the use of a connection board, as shown in Fig. 5. Here the dynamos lead to a terminal board near the dynamo, having four ends on the dynamo side, there being three dynamo leads from the dynamos.

Normally the dynamo is connected, as shown in Fig. 5, but by replacing the bars, as shown in Figs. 6 and 7, the positive dynamo, can be thrown over to the negative side, or the negative dynamo can be thrown over to the positive side. This arrangement does away with one main from the dynamo, and also puts in this circuit a permanent connection of low resistance, instead of a dynamo headboard switch, which is very rarely used. These changes can be made in a few minutes, and where the units are large, and the station capacity has not much surplus over the crest of the load curve, it is very important to be able to use ½ a unit against smaller units on the other side of the system.

In regard to the feeder board, see Fig. 8, this has much the same provision for putting in different feeders on the different potential busses as is used in a dynamo board. The switches "B B," etc., can be thrown on any bus, connecting that feeder into that bus. The provision for having a double contact on bus terminal "G" is so, that the time for opening the feeder to throw it to another pressure bus can be reduced to a minimum, the operation being as follows:

Bring the idle blade of the feeder switch as near the contact terminal as convenient, then the connection which the feeder now makes to the other potential bus can be severed and the new connection made very quickly so that the feeder will be open only for a very short period. This board has been divided into two sides, positive and negative, for the reason that it simplifes the bus bar connections and reduces the height of the board. All feeders being even numbers have their neutrals on the right, and all feeders being odd numbers have their neutrals on the left. The ammeters used are the Standard Edison.

Digitized by Google

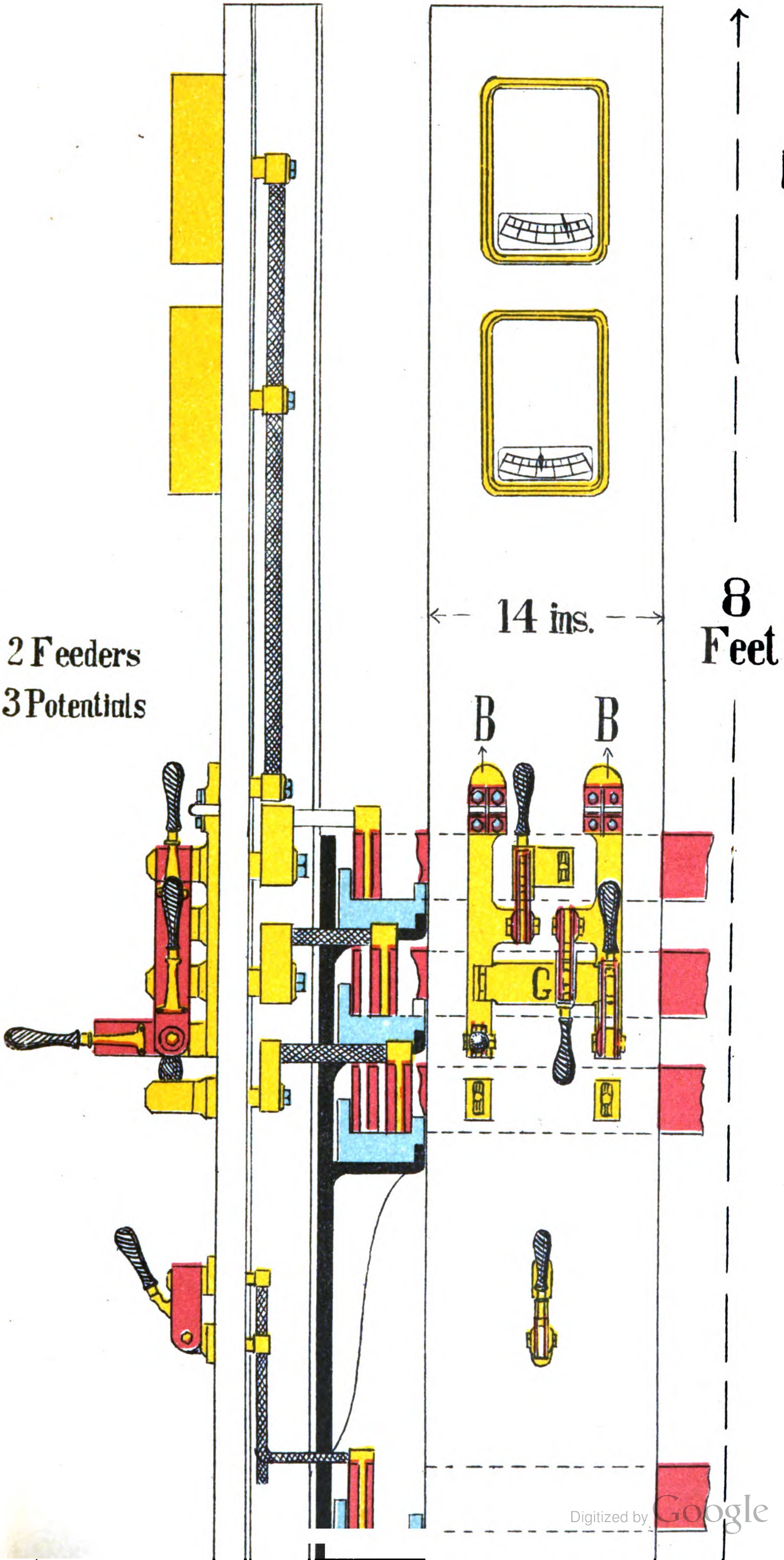


FIG. 8

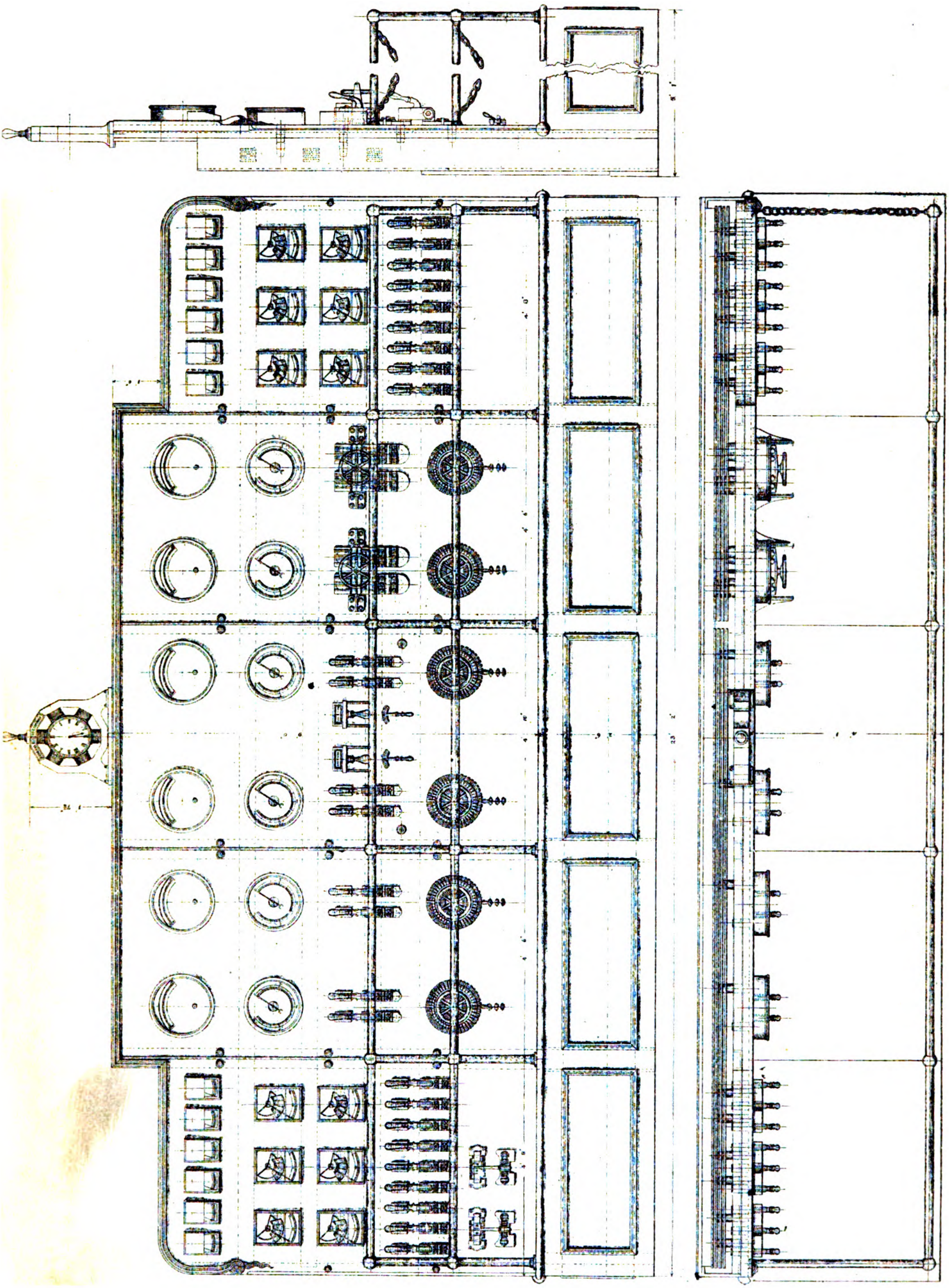
Digitized by Google

Digitized by Google

Fig. 10.

Digitized by Google

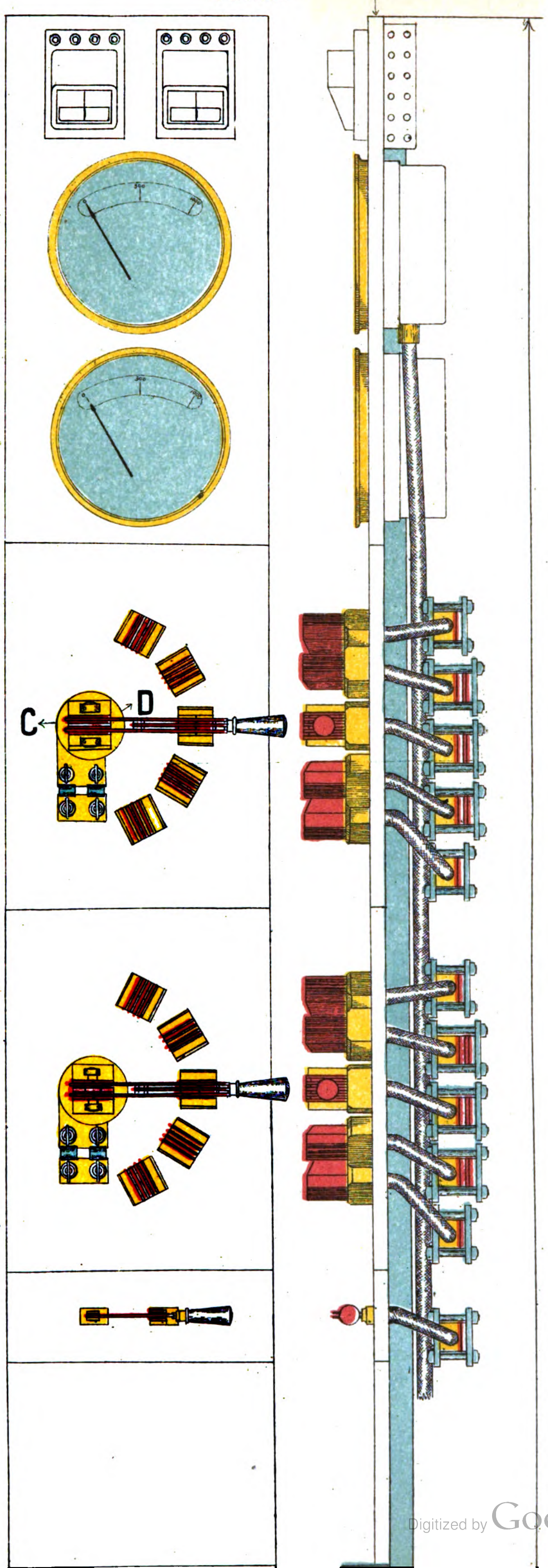
Digitized by Google



Digitized by Google

Digitized by Google

FIG. 12



Digitized by Google

Digitized by Google

Fig. 9 shows one half the complete arrangement of a board for two positive and two negative boosters, and sixteen 200 K. W. direct driven generators. The panels for this switchboard are designed to be interchangeable, the 100, 200 and 400 K W. panels being all the same size, their width being 16", and are made up right or left to suit the side of the switchboard to which they belong. The ammeter is the only thing that makes the panel right or left, and these can be readily interchanged. Each of the feeder panels are provided to take four feeders, and their width is 3' 8", and total number of feeders 24, and a maximum capacity of 800 amperes each. Total length of board 45' 8", with an output of 32,000 amperes. This board was gotten up for Mr. Brock, General Manager of the Paterson Company, for his new station, and embodies many of his ideas.

Fig. 10 shows a switchboard where the dynamo regulator, field switch, dynamo switch, volt meter and ammeter are assembled on one board. This switchboard I designed to meet the specials conditions for the World's Fair light and power system. There are two pairs of 150 K. W. Bipolars, and one pair of 400 K. W. multipolar panels, and three 3-wire feeders on each side of the board. The dynamo galvanometer and switches are located on the center panel. Iron clad comparative indicators are used for the feeder pressures.

Fig. 12 shows the arrangement adopted by Mr. Edgar in his Atlantic Avenue Station, where the feeder regulation is effected wholly by supplementary busses, no resistance being inserted in the feeders, the potentials of the different dynamos being varied to accommodate themselves to the requirements of the feeders attached to each bus, and the feeders being transferred from one bus to another to further vary the voltage on those feeders. The feeder switches are of special construction, having one end of the blade pivotted at "C," and can be swung around in position to engage with any desired bus. There is also a cam "D" in the pivot of this blade, which draws the contact surfaces of the pivot together when the blade is thrown into the clip. This board has the positive and negative feeder switches on one panel. The dynamo regulation and control is effected from one board centrally located.

Mr. Van Vleck has carried the matter of concentration of the switchboard appliances to the limit in his new Elm Street Station switchboard, and has devised the instruments and appliances with this in view.

The general layout is shown on Fig. 13. The dynamo ampere meters A are in front of the platform of the gallery fronting the station. These are for 800 K. W. direct driven, and are calibrated for 8,000 amperes. The dynamo regulator B is a quadrant form of commutator, and in the same plane as the ampere meters. The segments are connected to the regulator box by a cable of insulated wires.

The dynamo C switch is located directly in front of the dynamo ammeter and directly below the dynamo regulator. The dynamo switch is provided with a supplementary and main bus bar clip. The feeders are located directly behind the dynamo regulating board, and each feeder is allowed a space of three inches. The ammeters D are set edgewise, and are

Digitized by Google

connected to the feeders leading to the mains in such an order that the various hands of the ammeters will make a load curve for the system of distribution. The volt meters E take their drop directly across the feeder ends at the mains. This in the same way gives a curve of the fall of potential along the mains. This feeder board is divided into two halves, positive and negative. The feeder switches are provided with two clips, taking the current from the main or supplementary bus to vary the potential on the feeder. The safety fuses are staggered, so as to get sufficient distance between them, and in 36 feet he gets 66 feeders, with a maximum capacity of 1,800 amperes each. The main ampere meters F are to carry 100,000 amperes on a side. The current is carried through them by means of a positive and negative neutral, all the positive dynamos being brought to one neutral, and all the negative dynamos are brought to the other. These two neutrals are combined after passing through the main ammeters to the common neutral for the feeders. The main ammeters, I believe, are being made by White & Co., under Lord Kelvin's instructions.

Whether such an output can be successfully handled in the space allotted to it has yet to be developed by practice, but great care will have to be exercised in shielding the instruments from mutual influence. Mr. Van Vleck has named this method of building switchboards the "Edgewise System," and this principle has been carried out in every appliance designed for this board.

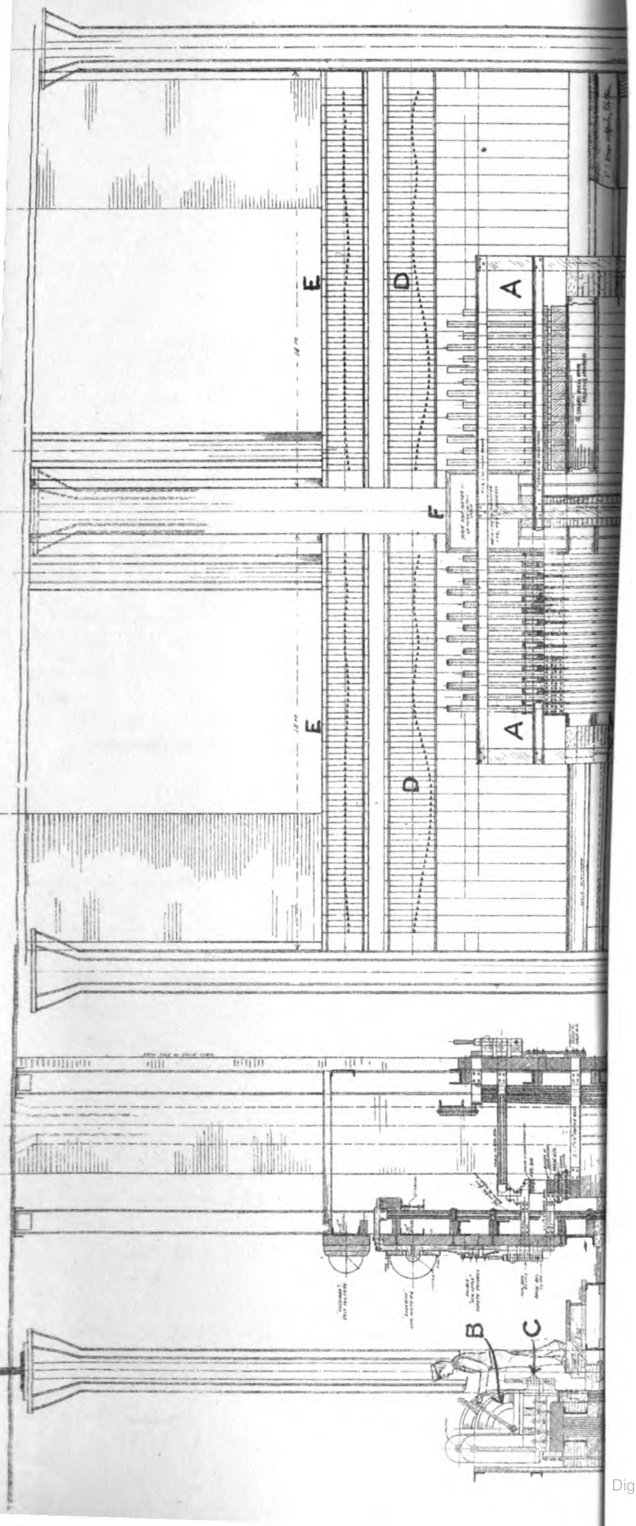
In regard to the methods used in feeder regulation, the following are the principal ones that have been applied and proposed: The Equalizer, the Supplementary Bus, the Booster, the Supplementary Bus with Resistance and Supplementary Busses Feeding from One Bus to another.

In order to show graphically the relative efficiency of some of these methods, four feeders are taken through the same loads, applying to them the different methods of regulation, and the watts lost by each method are given in a shaded area adjacent to the current curves. The first set of curves, Fig. 14, gives the Equalizer Method, where resistance is inserted in the feeder sufficient to bring the main to an equal potential, while the load varies throughout the system, the pressure being raised in the station (see red line "A,") to accommodate the maximum voltage necessary. The watts lost in this method could not be laid out on the same scale as shown in Fig. 15, but from the squares which do show relative watts lost between the Equalizer and the Supplementary Bus, with Resistance method, it is readily accounted for why the equalizer has been short circuited and more copper put in the system in a number of the stations, which has proved a much more economical method of pressure distribution. These stations are now again becoming loaded with their large copper plant, and some method must be resorted to by which the feeder pressure can be varied.

Curve, Fig. 15, shows the economy of Supplementary Bus with Resistance method. The black line "B" gives the current taken on each feeder, and the voltage that is maintained on the supplementary busses is given in red on the first bus and blue on the second, and also the shaded area of losses is given in the color which corresponds with the bus to which the feeder is attached.

Digitized by Google

g Equalize
ssure.



Digitized by Google

con
vari
dist
end
pote
posi
taki
pote
suffi
max
to c
by 1
brou
The
to th
bein

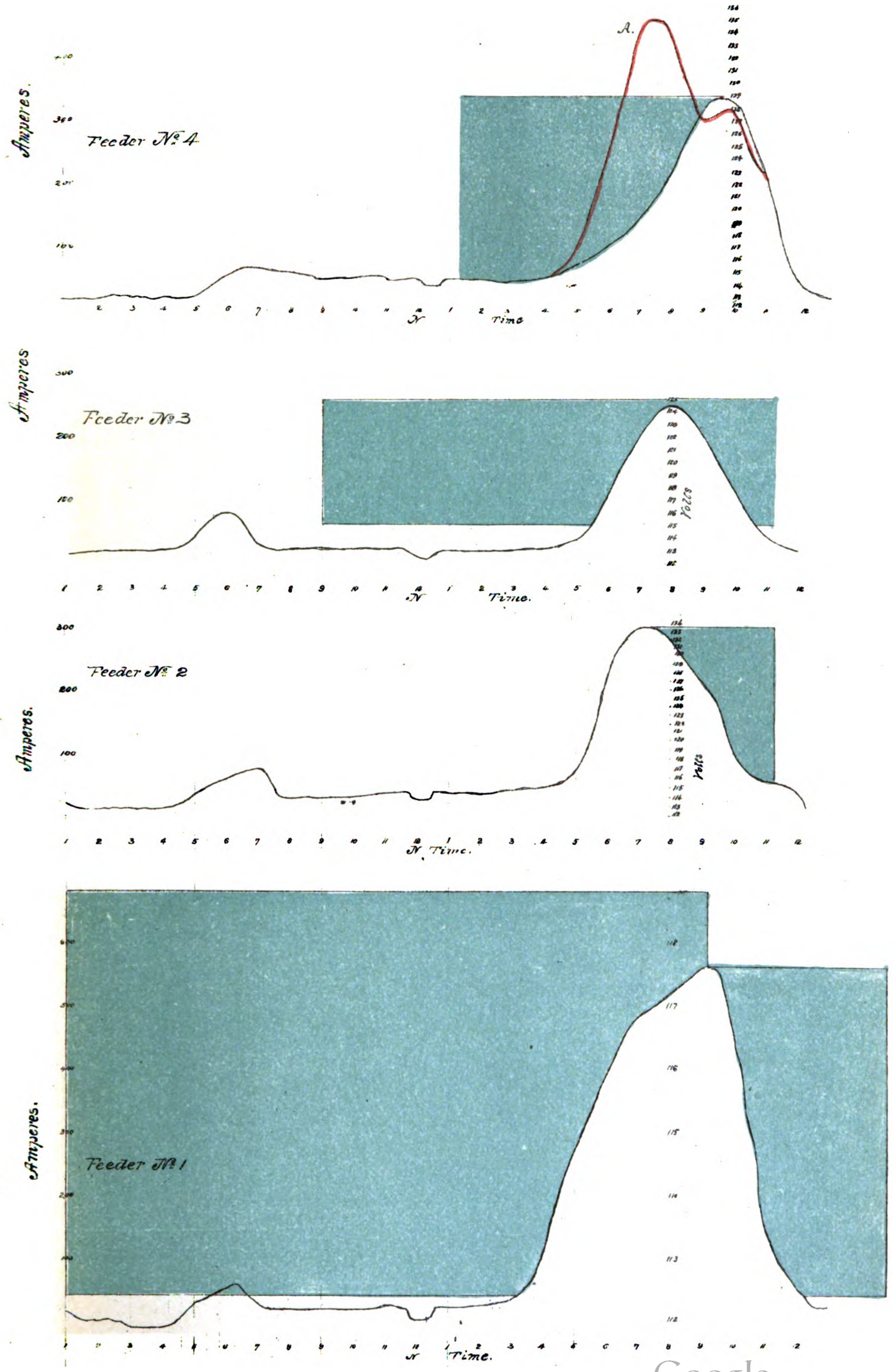
ed t
exe
Vle
Syst
sign

the
the
ance

meth
the
give
curv
the 1
varie
red
watt
in F
the
read
copp
much
now
must

ance
and
red
losse
feed

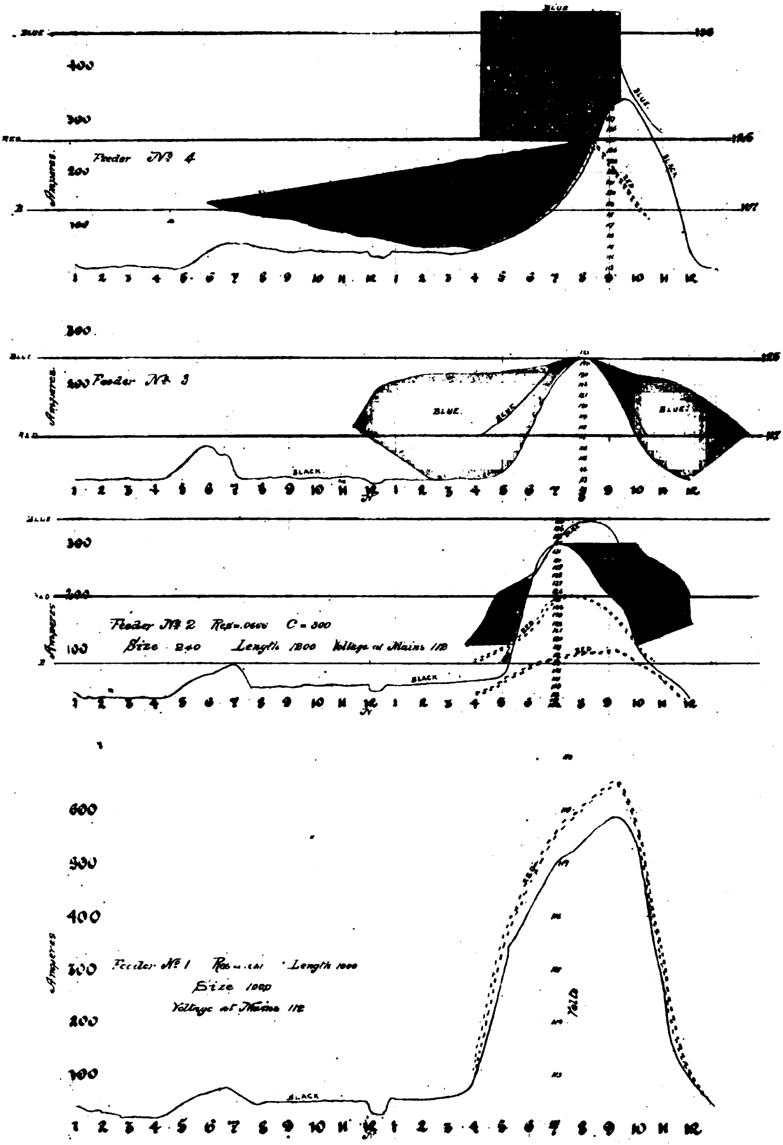
Loses on 4 Feeders useing Equalizer for Varying Feeder Pressure.



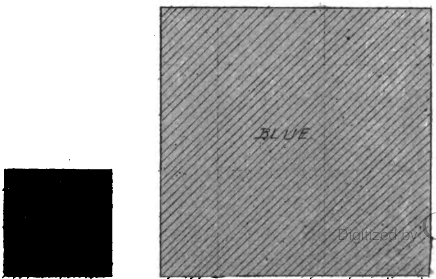
Digitized by Google

Digitized by Google

Supplementary Busses and Resistances is Used.



Relative Watts lost in regulating Feeders by Equalizer and Suplementary Bus and Resistance.



Digitized by Google

Digitized by Google

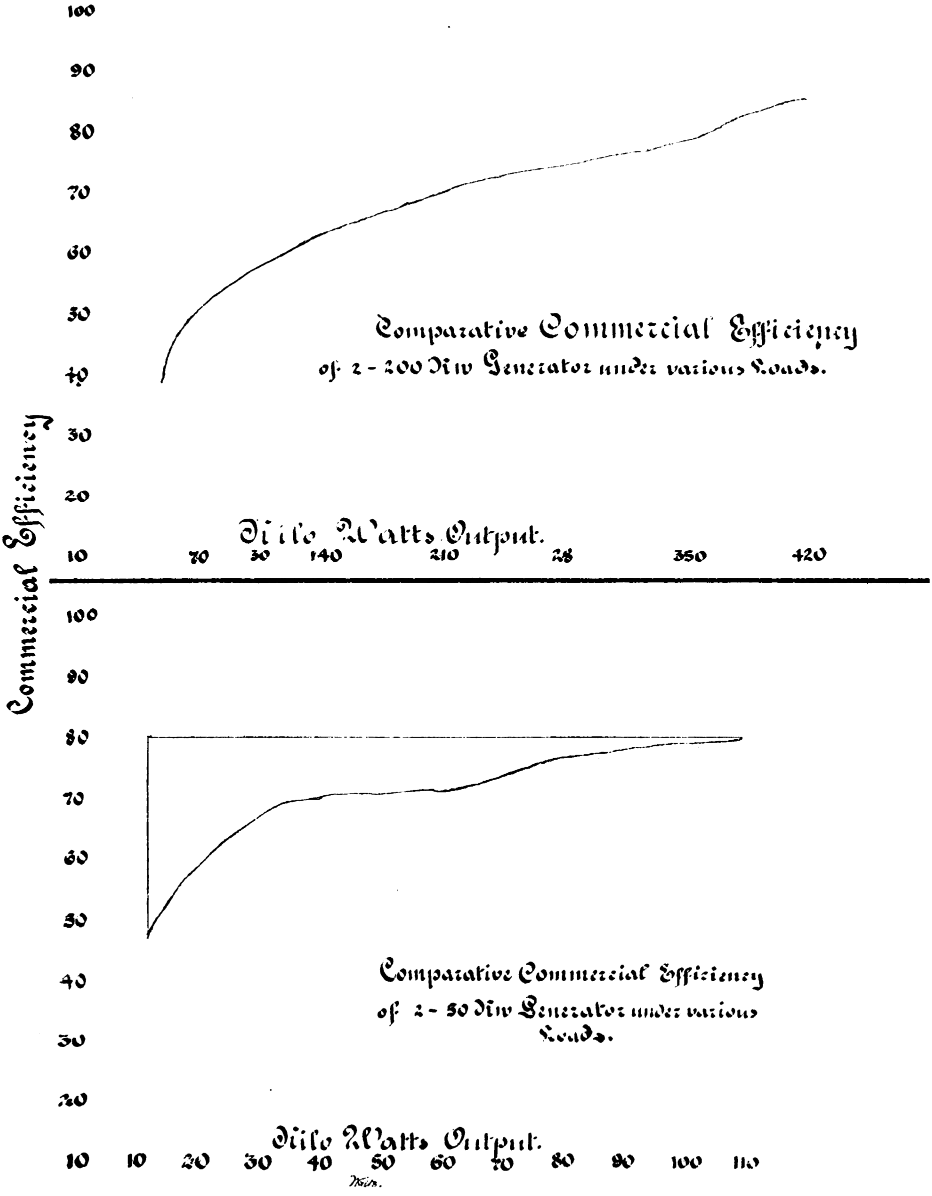


Fig. 16.

Digitized by Google

Digitized by Google

Curve, Fig. 16, gives the efficiencies, as determined by Mr. Vail of our 50 K. W. Direct Driven Generator, on different loads, and our 200 K. W. Direct Driven Generator. These curves show at a glance how much is gained by keeping the unit loaded in commercial efficiency. In the Supplementary Bus Method, where it is necessary to have a dynamo on each supplementary bus used, if the units on these busses cannot be kept fully loaded, the output is generated at a low efficiency. To improve the total efficiency of the output of the station when there are only light loads on the supplementary busses Mr. Barstow has devised the Booster. This is a low volt high current dynamo, by means of which the voltage of the main bus is exalted and the current with added electro motive force is delivered from the main bus to the supplementary busses, one booster being used for each supplementary bus. This gets over the objection of running separate dynamos on supplementary busses at low loads, as the whole station can be run from one or two units fully loaded, the booster having sufficient capacity to carry the load of the smallest unit. When the booster is loaded a unit can be thrown on this bus and the booster taken off, and the loss due to the second transformation through the booster is obviated. In the case of the secondary busses fed from one bus to another, the resistance between them being also the feeder resistance (see Fig. 17), the units can be fully loaded. The losses in this resistance in this method is offset by the losses in secondary transformation in the booster method. The same ends have been accomplished, I believe, abroad for several years. The storage battery has been used for varying volts on the different feeders, and this method should give fairly economical results where the depreciation in the storage battery has been reduced so as to make them a good investment.

The operation of the system of supplementary busses with switches to throw resistance between the busses, and also to regulate the pressure on the feeder, is as follows:

If the feeder is thrown in on Bus "A," see Fig. 17, and if the contact arm of the resistance device is thrown on contact clip D^1 and D^2, the feeder is then at the same potential as Bus "A." If the potential of the feeder still requires lowering the arm can be moved to insert resistance "R," but if the volts of the feeder requires raising, the switch "B" can be thrown in and the current will flow through the resistance from one bus to the other, this resistance being such that no more than one-third of the feeder capacity can flow through this resistance at the maximum difference of potential maintained between the two busses.

The potential on the feeder can then be varied between "A" and "B," and when the contact arm has reached the contact E^2, the potential of the feeder is then the same potential as the bus "B." The switch can be withdrawn from the bus "A" and thrown in "B," not opening the feeder, simply feeding it through a resistance. The arm can then be moved back to the clips "D^1 D^2" and the switch can be disengaged from "B" and thrown on "C," and then again the resistance can be raised between "B" and "C." The advantage this form of resistance has is, that the resistance between the bus bar remains constant, while the resistance to the feeder can

Digitized by Google

be varied, and it is not essential that the resistance be connected across the bus bar except in case the unit working on the bus bar is not sufficiently loaded. By allowing the current to flow through the resistance between the bus bars the drop is increased on that part which carries the current of the feeder, and consequently part of the current flowing to "A" will be diverted through the feeder, and the system will not be effected by the variation on the feeder. This is a proposed scheme by which considerable economy in feeder regulation can be effected.

The general practice is to locate the switchboard in a gallery on one of the walls of the station, which gives the least distance to run the cables from the dynamos to the tube boxes through the switchboard.

Fig. 18 shows a switchboard gallery recently designed for Paterson. The iron framework for the switchboard we are now making out of standard steel channels. The framework is made in sections and can be readily taken down, and where it is secured to any conducting portions of the station building it should be carefully insulated from it. The frame is usually set on top of the slate floor, which makes a very serviceable flooring for a gallery, and all bolts going through the iron framework of the switchboard should be insulated when they are in contact with the beams under the floor. With a grounded neutral the insulated iron framework has great advantages, both in regard to leakage and working behind the board. A four foot space should be allowed between the walls and the switchboard for convenience in working and erecting.

In the case of Fig. 18, the different sections carrying arc light, railway and incandescent circuits are also insulated from each other. The material best adapted for the switchboard slabs are slate, a chocolate colored fine grained Tenessee marble and Italian marble. There is also a light gray marble used largely in the West, which makes a very effective and substantial board. The Italian marble makes a very handsome board, but it gets discolored in time by the effects of oil and dirt. Tennessee marble of proper quality should drill nearly as readily as slate, and is the most durable of all. For connecting the instruments and switches to the bus bars and cables we use a taper plug lug ground to a fit, which gives an excellent contact.

We have also gotten up a line of porcelain insulators for station wiring for bare cable or copper rod, which can be built up in any form to lead the conductors through the station, either on the iron framework or recesses in the wall, see Fig. 19. The cost of station conductors can be cut about 20% by the use of bare conductors. Solid copper rod on porcelain insulators gives very high insulation, and in exposed places they can be served with asbestos twine, which affords the conductors protection from mechanical injury, and fire cannot be transferred along the conductors to other parts of the building. A welding machine is very useful in connecting the adjacent lengths of copper rod, and provision for expansion is made at elbows by a flexible laminated "L." We also make a bus bar support of porcelain, shown in Fig. 3, side view, by this means doing away with all inflammable material in the switchboard or wiring of the station, hoping by these precautions to reduce the insurance risk on this class of property.

Digitized by Google

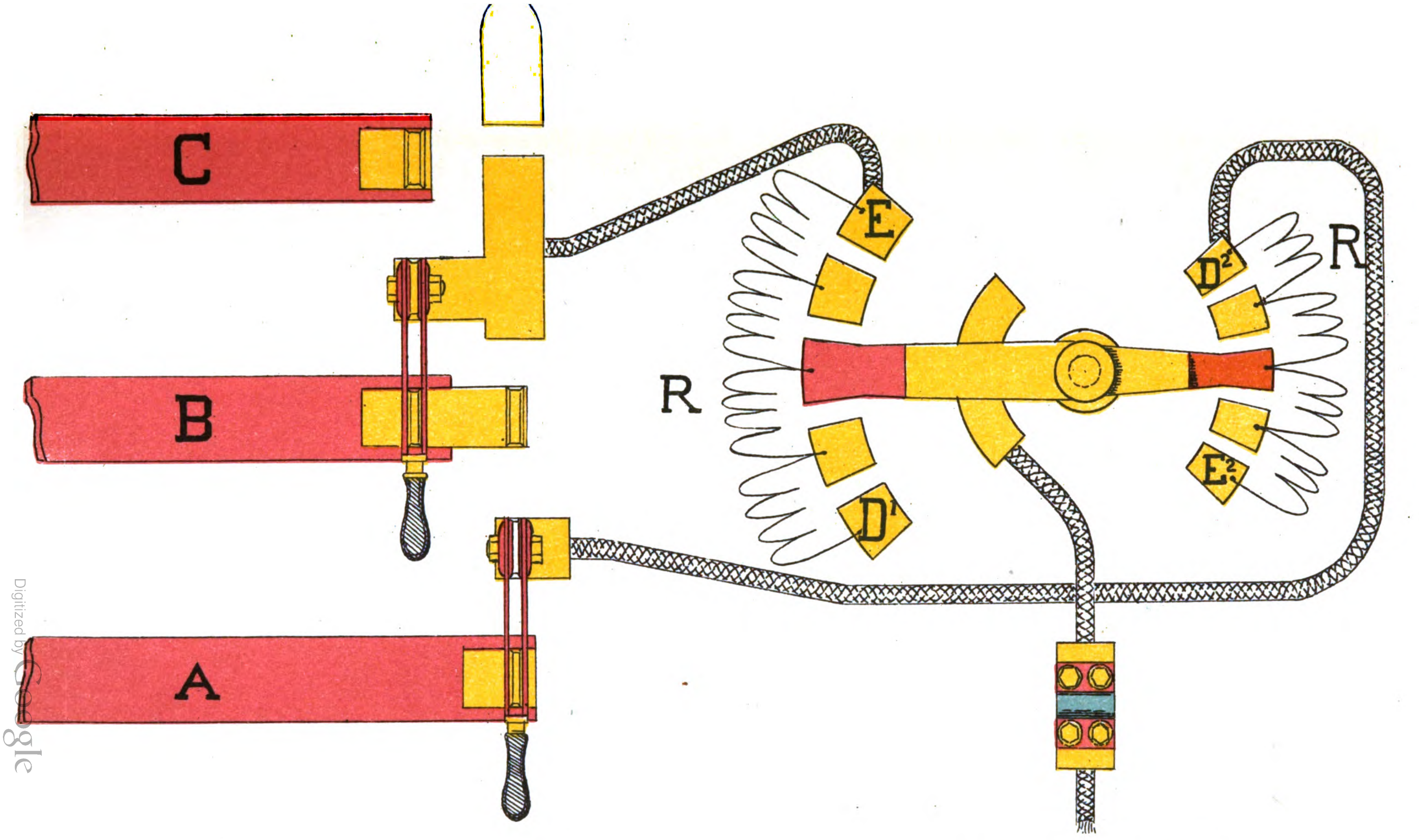
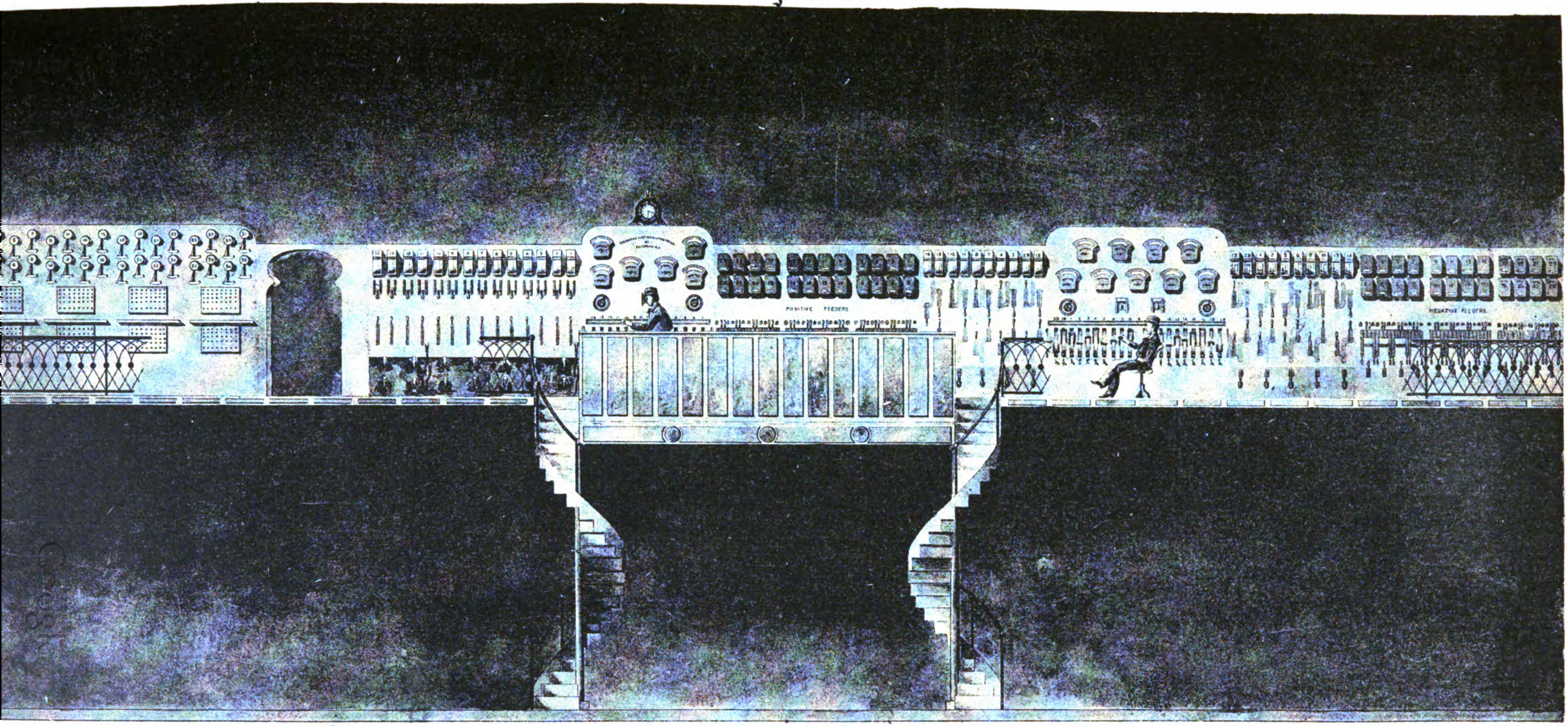


FIG. 17.

Digitized by Google

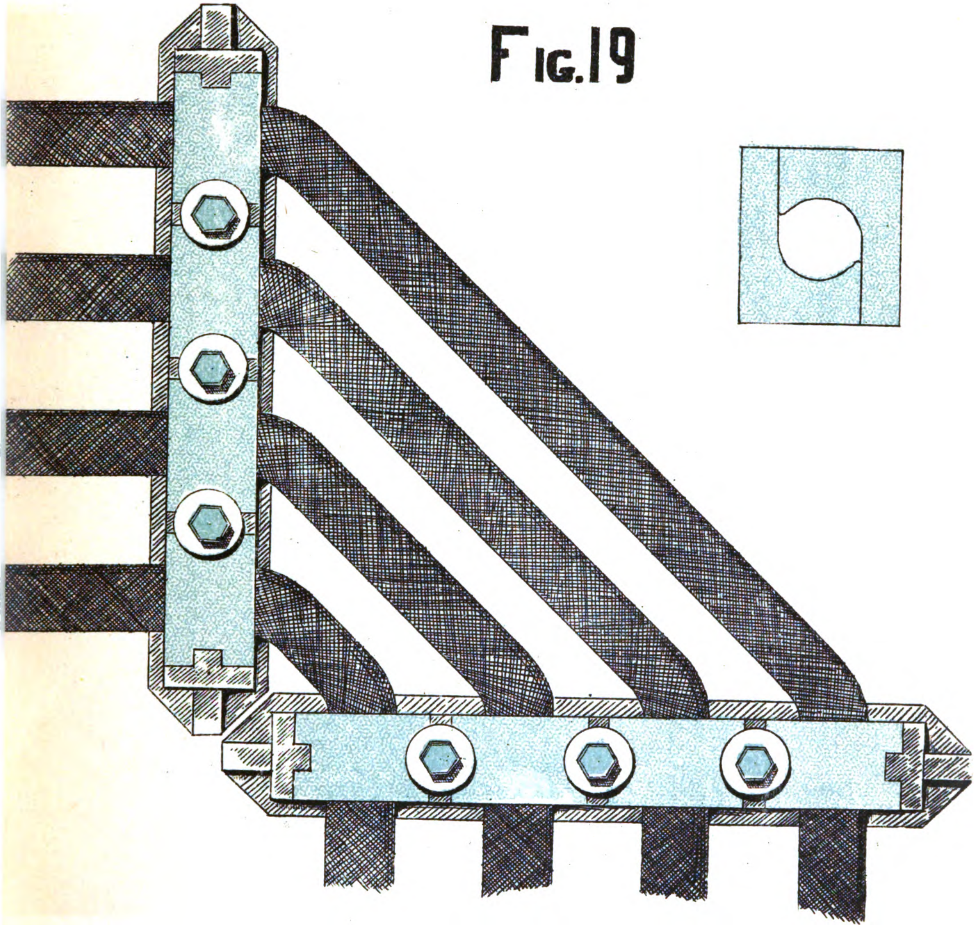
Fig. 18.



Accepted Arrangement for Paterson Illuminating Company Switchboard.

Digitized by Google

FIG. 19



Digitized by Google

Digitized by Google

It will also be noticed that all conducting parts and switch contacts are made more massive than in the old type appliances. The economy of this is very apparent; for instance, if a thousand ampere switch was used which had an average elevation of temperature of 20° C above the average air temperature of the station, this would mean an average loss of 72.2 watts. With electrical horse-power delivered at $60.00 per year, the energy expended in heating this switch will cost nearly $6.00 per year, or 19% loss on the investment per year. From this it is evident that a switch possessing more material and contact surface would be a very economical investment. These points of sufficient carrying capacity do not become evident until the station becomes fully loaded.

THE PRESIDENT: The paper of Mr. Herrick is before the Association, and as this is a very important matter, and one in which every Central Station Manager, and every party connected in any way with Central Stations is interested, I think it should be very thoroughly discussed, and I take it that it will be. Station superintendents, electricians and managers can derive great benefit from it when they go to reconstruct their switchboards.

MR. EDGAR: I think that paper is so important that I wish the Association would decide to have it printed at once as a separate paper. I think it is the best paper I have heard here, and I think it would be of interest to the large owners of plants as well as small ones. The Secretary should be instructed to get this out as a separate paper at once.

THE PRESIDENT: Would it not likewise be well to have it illustrated with cuts as far as possible?

MR. EDGAR: They look as if they were finished drawings (indicating the wall prints with which the paper was explained during its reading) so that they could be photographed almost immediately.

THE PRESIDENT: I think the suggestion of Mr. Edgar is a very valuable one and should be carried out. But, if there are any suggestions or improvements to offer, we would be pleased to have them.

MR. EDGAR: I think there is one point where I do not agree with Mr. Herrick. I do not think he does justice to the "Booster" system. The "Booster" system, in connection with multiple wires for raising and lowering the resistances, is not touched upon by him. We have found it very valuable.

MR. HERRICK: I had not intended bringing out the "Booster" system, as I understand this is covered by another paper, which will be read before the association.

MR. EDGAR: I did not know that. The "Booster" system I think a very important thing.

THE PRESIDENT: While at Chicago, some time since, I had occasion to criticise and supervise the construction of a number of switchboards, and I found a sort of Georgia Marble which gave, as far as drilling and durability is concerned, all the desirable qualities of marble without having the thickness. Mr. Gilbert and I, while in the electricity building, also ran across a Tennessee Marble which gives a somber appearance, and the instru-

Digitized by Google

ments do not stand out as well as on a lighter colored board. The Italian marble, in my opinion, is too white, and has a tendency to get soiled very easily.

MR. EDGAR: I move that the paper of Mr. Herrick be received by the Association and entered in full upon the Minutes, and that the thanks of the Association be tendered to Mr. Herrick for the care shown in its preparation and for the drawings which accompany it, and that the Secretary make immediate arrangements to have it set up in type for incorporating in the Minutes, and that several copies be printed and issued to each of the members of the association without delay.

MR. GREENE: I would like to say something on that motion. The General Electric Company is going to have that paper printed, and will probably include some more drawings, which have been carefully revised. We are going to do that right away, and I would simply say to the Association that we would be glad to furnish the members copies, and in this way the Association might avoid the necessity of having them printed.

THE PRESIDENT: That is very valuable to us, as it will be quite a saving of money. I take it that the Association will avail itself of the very kind offer of Mr. Greene, and that a sufficient number of copies will be put into the hands of the Secretary of this Association, so that he can mail one to each member as soon as they come from the press.

MR. GREENE: I will be glad to see that this is done.

On motion of Mr. Edgar, the paper of Mr. Herrick was received by the Association and ordered entered in full upon the Minutes, and the thanks of the Association were extended to Mr. Greene for his kindness in tendering a sufficient number of copies of the paper for distribution among the members.

Report of the Treasurer.

The Treasurer presented the following report, which was endorsed by C. L. Edgar and C. P. Gilbert, as representing the Executive Committee:

CHICAGO, AUGUST 8, 1893.

RECEIPTS.

Cash received from last year's report	$ 928 82
Cash received from dues, 1892–1893	463 00
Total cash received	$1,391 82
EXPENDITURES for 1892–1893	$739 70
Balance on hand	$652 12

Correct.

WILSON S. HOWELL, *Treasurer.*

Digitized by Google

In reply to questions by members, the Treasurer stated that there are about fifty paying members in the Association.*

On the motion of Mr. Gilbert, it was ordered that the report of the Treasurer be accepted and spread upon the Minutes.

Professor Kennelly's Paper.

A paper as follows was presented, and a portion of it read by Professor A. E. Kennelly, of the Edison Laboratory:

On the Carrying Capacity of Electric Cables Submerged, Buried, or Suspended in Air. By A. E. Kennelly.

The general laws that control the temperature elevation of electrically active wires when buried or submerged seem to have been fully ascertained, but the application of the theory to practical conditions has not, perhaps, been sufficiently developed. Professor George Forbes has, however, in his paper on the heating of conductors read before the London Institution of Electrical Engineers in March, 1884, considered the cases of wires in air and water, as well as of wide horizontal plane strip conductors buried underground. It is here proposed to further develop the subject, with the aid of a series of measurements made at the Edison Laboratory on particular samples of Siemens cable manufactured at the Schenectady Works of the General Electric company. These measurements are described in Appendix I.

We may commence with the simplest case of a solid cylindrical conductor of radius r cms. carrying a steady current of C amperes with a resistivity at the working temperature of α ohms. The conductor is covered to radius R cms. with a solid insulating material, closely fitting over which is a tube or cylindrical sheathing of lead or other metal. The electrical resistance of the conductor per centimetre of length is $\rho = \frac{\alpha}{\pi r^2}$ and the heat generated by the current in the same unit length is $C^2\rho$ Joules per second corresponding to a thermal activity of $C^2\rho$ watts.

If the surface of the cable's sheathing is kept at a constant temperature t degrees Centigrade, by the action of flowing water, it can be shown that, in the copper conductor, there will be no sensible difference of temperature between the center and the surface for all cases that are likely to occur in practice. Similarly the difference of temperature between the interior and exterior surfaces of the leaden sheath will be negligible, so that finally, after the current has been kept steadily flowing through the conductor for what would be strictly an infinitely long time, but for practical purposes might be an hour, we may consider that while the sheath would retain throughout a uniform temperature t° C., the copper would have reached a

*A list of the members on the roll, at the date of the Chicago Convention, is given at the opening of this Report.—SECRETARY.

Digitized by Google

steady temperature of $t + \theta$ throughout its substance, θ being the temperature elevation of the conductor due to the current it conveys.

This temperature elevation θ depends upon the thermal resistance offered by the insulator to the transfer of $C^2 \rho$ Joules of heat energy across unit cable length of its substance per second. With infinitely great thermal conductivity or infinitely small thermal resistance, the insulator would transfer heat under an infinitely small temperature elevation ; and generally, if S is the thermal resistance of a body between two surfaces whose difference of temperature or thermal potential is θ °C (referred, strictly speaking, to the Centigrade scale of the air-thermometer) the transfer of heat in the permanent state between those surfaces will be $H = \frac{\theta}{S}$ . . . . . (1)

heat units per second. It is customary to express H in gramme-calories, *i. e.*, water-gramme-degrees Centigrade, but for the purposes here in view, it is preferable to express the heat in terms of its equivalent mechanical energy, with the Joule as unit.

The thermal resistance of a body depends upon its form and its thermal resistivity, in complete analogy with the corresponding electrical quantities. A homogeneous isotropic substance possesses therefore unit resistivity when a centimetre cube with 1° C. difference of temperature maintained between two opposite faces, allows one Joule of heat energy to pass between them, in the permanent state, each second. If σ denotes the thermal resistivity of the insulator in the cable of radii r and R, the thermal resistance of the covering per centimetre of length of cable is $S = \frac{\sigma}{2\pi} \log_{\varepsilon} \frac{R}{r}$ . . . . (2)

and by analogy with Ohm's law, the temperature elevation will be the product of this resistance and the energy current H or $(C^2 \rho)$ developed in each centimetre. Thus $\theta = \quad H S$ . . . . (3)

$$\text{and } C = \sqrt{\frac{\theta}{\rho S}} \quad \ldots\ldots \quad (4)$$

This relation (4) determines the limiting current strength for the cable, when the radii and resistivity of the insulator are given, and the temperature elevation has been decided upon.

The temperature elevation permissible in the conductor of a cable is generally limited by the attendant diminution of insulation resistance, or the softening of the insulator material. For Siemens cables, 60° C. may be taken as a fair limit in this respect, and since the normal temperature of air or soil may reach 35° C. in summer, the safe limit of temperature elevation will be 25° C. or 45° Fahr.

With this value of θ in equation (4)

$$C = \frac{5}{\sqrt{\rho S}} \quad \ldots\ldots \quad (5)$$

$$\text{or developing} \quad C = 5 r \sqrt{\frac{2\pi^2}{\alpha \sigma \log_{\varepsilon} \frac{R}{r}}} \quad \ldots\ldots \quad (6)$$

Digitized by Google

α and σ being the electrical and thermal resistivities, ρ and S the electrical and thermal resistances per cm. of length, R and r the radii, and the conductor a solid cylinder.

This shows that if the thickness of the insulating cover maintained a constant ratio to the diameter of the conductor, the limiting current strength would be directly proportional to the radius, that is to the square root of the cross sectional area of the conductor. In that case doubling the diameter of the wire would quadruple its cross section, but only double the carrying capacity. It is evident, however, from an examination of the dimension tables for any kind of electrical cable, that the thickness of insulator does not usually increase in proportion to the diameter of the wire, and, consequently, the carrying capacity will generally increase faster than the radius, and slower than the cross section. For the standard Siemens cables it appears that quadrupling the cross section of the conductor increases the carrying capacity about three times.

The resistivity of copper at 60° C. may be taken as two microhms, and from the measurements of the samples of Siemens cable tested, the mean thermal resistivity of the insulator was 750 units.

As an example, suppose a No. 4 B. & S. wire 0.2043″ (0.52 cm.) in diameter, covered with Siemens compound to a thickness of 0.1″ (0.254 cm.) lead sheathed, and submerged in water. Required the safe carrying capacity.

In equation (2) $\sigma = 750$ $\quad$ $R = 0.514$ $\quad$ $r = 0.26$ $\quad$ $R/r = 1.977$

$$\log_{\varepsilon}\left(\frac{R}{r}\right) = 0.6816.$$

$$S = \frac{750}{6.283} \times 0.6816 = 81.36.$$

$$\text{Also } \rho = \frac{0.000002}{3.1416 \times 0.26 \times 0.26} = 0.000009417.$$

$$C = \frac{5}{\sqrt{81.36 \times 0.000009417}} = 180.7 \text{ amperes.}$$

Stranded Conductors.

If the copper conductor consists of a strand of copper wires equations (4) and (5) remain applicable, but (6) is no longer reliable. Taking (5) the resistance of the conductor per cm. can be determined in the ordinary way, and the thermal resistance of the insulator can be best found by taking its mean internal diameter for r in (2). The insulating cover surrounding and conforming to such a strand is no longer simply cylindrical, but the slight additional accuracy in determining the thermal resistance for the new interior outline would not repay the additional labor of computation.

Buried Cables.

The case of buried cables differs from that of cables submerged only in the fact that the external surface of the sheathing is not maintained at the normal temperature of the environment. The ground in fact interposes an

Digitized by Google

additional thermal resistance to the flow of heat from the active conductor. Denoting this ground resistance by G, the fundamental equation (1) becomes

$$H = \frac{\theta}{S + G} \quad \text{. . . . . (7)}$$

so that it is only necessary to increase the thermal resistance of the insulator by that of the soil to revert to the same method of treating the problem.

Assuming that the cable lies buried at a uniform depth below the level surface of the ground, the thermal resistance G of the soil, will for a given external cable diameter depend only upon this depth and upon the thermal resistivity of the soil. We may consider that the temperature of the surface of the ground remains normal, and that owing to the combined actions of radiation, convection, and wind, the heat flowing upwards from the buried cable is entirely dispersed and dissipated at this surface. This is, of course, not strictly true, for the surface temperature of the ground immediately over the cable will rise appreciably when powerful currents are steadily carried beneath. It may be shewn, however, that with the depths at which cables are usually buried, the assumption involves an error that is practically small, while it renders amenable to simple numerical treatment, a condition that would otherwise be too complex to ordinarily compute. If, for example, a cable buried at a depth of one metre were of such dimensions as to carry safely a steady current of 750 amperes, the final elevation of temperature at the surface of the ground over it would be less than 2°C., even ignoring the great reducing influence of wind, and the ground surface which, by assumption, should remain at normal, could nowhere exceed the normal by two degrees Centigrade, a discrepancy whose consequence upon the carrying capacity of the cable would be negligible, and whose tendency would be to slightly underestimate the temperature elevation of the conductor.

On this assumption, then, the surfaces of heat flow are cylindrical, and the isothermal surfaces are also cylinders eccentric to the conductor. The

thermal resistance $G = \frac{g}{2\pi} \log_{\varepsilon} (n + \sqrt{n^2 - 1})$ . . . . (8)

where g is the thermal resistivity of the soil, and n is the ratio of the depth of the cable's axis to the cable's radius, or, in other words, the depth of the center of the cable in external radii. From this formula the following table and the curve in Fig. 1 are obtained.

n.	Coefficient of g.	n.	Coefficient of g.	n.	Coefficient of g.	n.	Coefficient of g.
10	0.4760	60	0.7620	110	0.8584	160	0.9181
20	0.5871	70	0.7865	120	0.8730	170	0.9277
30	0.6516	80	0.8077	130	0.8850	180	0.9368
40	0.6975	90	0.8265	140	0.8968	190	0.9454
50	0.7330	100	0.8433	150	0.9078	200	0.9536

Digitized by Google

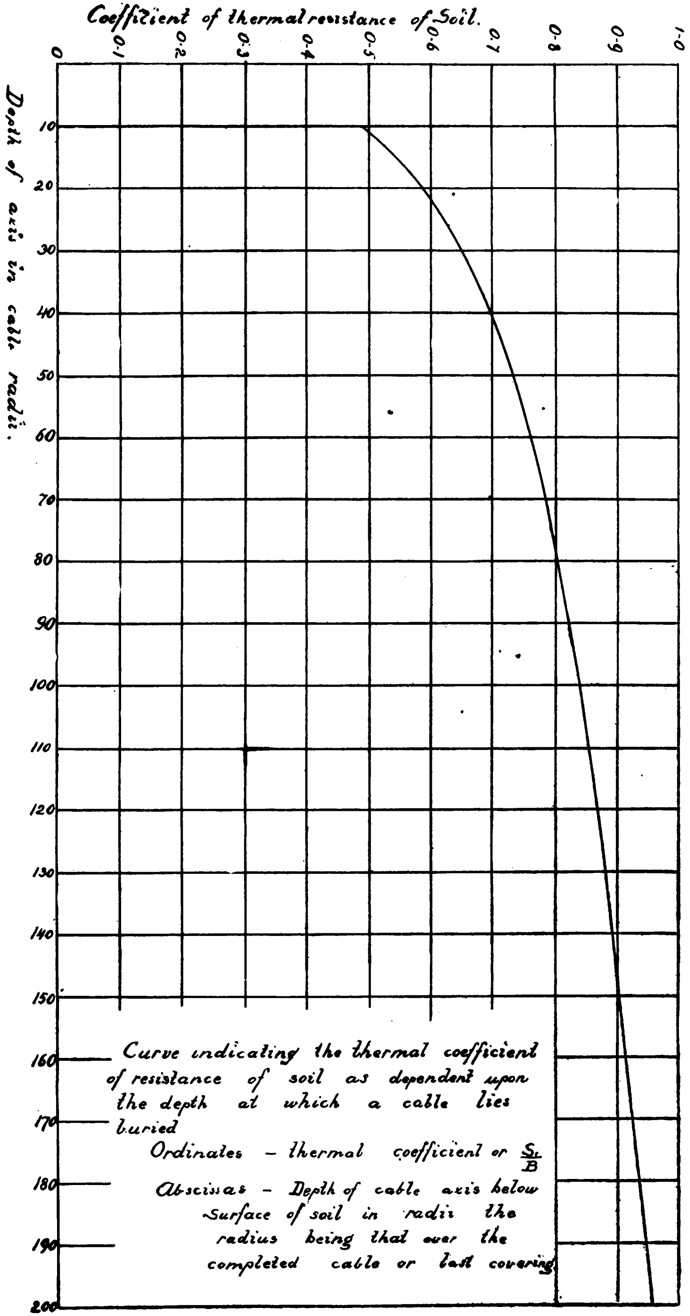

Coefficient of thermal resistance of Soil.
0
0·1
0·2
0·3
0·4
0·5
0·6
0·7
0·8
0·9
1·0
Depth of axis in cable radii.
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
Curve indicating the thermal coefficient of resistance of soil as dependent upon the depth at which a cable lies buried
Ordinates – thermal coefficient or S/B
Abscissas – Depth of cable axis below surface of soil in radii the radius being that over the completed cable or last covering

Fig:1.

From these curves it appears that at depths of fifty radii, a quadruple increase—to 200 radii—only changes the resistance per centimetre of length from $0.733g$ to $0.954g$, an increase of about 30%.

From the measurements made on the samples of buried cable the mean thermal resistivity of the sandy soil in which they rested was about 50 units, or fifteen times less than the mean resistivity of the insulator.

Formula (4) modified to include the thermal resistance of the ground becomes $C = \sqrt{\frac{\theta}{\rho(S+G)}}$ . . . . (9)

and with the safety limit of 25° C., here recommended for Siemens cables, (5) becomes $C = \frac{5}{\sqrt{\rho(S+G)}}$ . . . . (10)

As an example, suppose the cable previously considered to be buried at an axial depth of 2'.6'' (76.2 cms.), in a soil of resistivity 50. Here the depth in radii is 148.2, and reference to the preceding curve shows that the ground resistance per centimetre is $0.9\,g$, or in this instance 45 units. The thermal resistance of the insulator having been found to be 81.36, the total thermal resistance in the heat current path is 126.36. Substituting this in the formula (5) or (10)

$$C = \frac{5}{\sqrt{126.36 \times 0.000009417}} = 144.9 \text{ amperes.}$$

The computed drop in temperature within the cable will be $\frac{25 \times 81.36}{126.36} = 16.1°$ C.,* and the temperature elevation of the sheath 8.9° C.

INFLUENCE OF EXTERNAL LAYERS OF HEMP OR COMPOUND.

If the cable, instead of being simply sheathed in lead, has also, as is usually the case, additional coverings of jute and compound, with or without intermediate metal bands or wires, additional thermal resistance is again interposed by each layer of fibrous material, the thermal resistance of the metallic bands or wires being generally negligible in comparison. The thermal resistance of any cylindrical layer of resistivity σ_n and radii r_n and R_n is $S_n = \frac{\sigma_n}{2\pi} \log_\varepsilon \frac{R_n}{r_n}$ by formula (2), and since all these resistances are in series, the total thermal resistance per centimetre of cable length is $(S_1 + S_2 + S_3 + \quad + G)$, and this compound term should replace the symbol S in equation (4).

As the measurements referred to were all made on simple lead covered cable, information is still missing as to the value of the resistivity for these layers.

In computing the tables given in Appendix III, these resistivities have been assumed as equal to that of the Siemens insulator next to the copper, *i. e.*, $\sigma = 750$.

Digitized by Google

INFLUENCE OF NEIGHBORING ACTIVE CABLES.

If two or more active cables are buried in the same trench, they will exert a mutual thermal influence upon each other, and it becomes important to ascertain in what degree their proximity will influence their temperature elevations and safe carrying capacity.

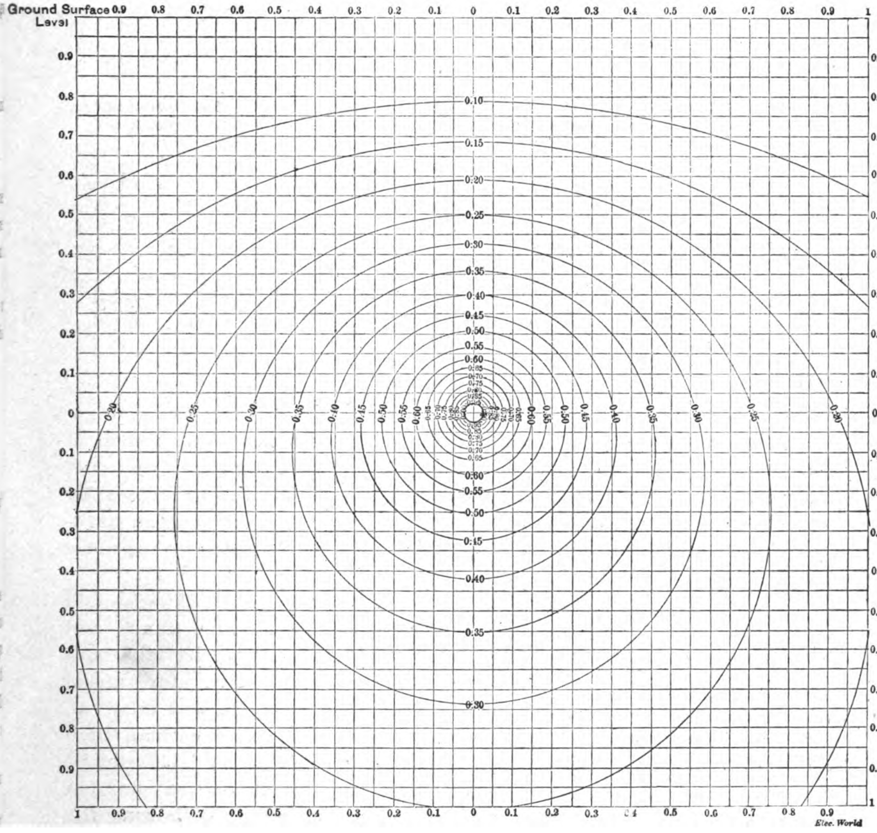


FIG. 2.

As an illustration of the distribution of temperature communicated to the soil in the vicinity of an active cable, Fig 2 represents the special case of a cable whose axis is buried forty radii below the ground surface. If the external diameter of the cable should be five cms. (1.97″), the depth will correspond to one metre (39.37″). Taking the temperature elevation at the external surface or sheath of the cable as standard, the circles indicate the sections of successive isothermal surfaces having 95%, 90%, 85%——10% of the

Digitized by Google

sheath elevation, the ground surface being the postulated surface of zero elevation. It is evident that, for a given distance from the cable, the temperature elevation is highest immediately beneath and lowest immediately above it. The following table, No. II, gives the horizontal distances at which these isotherms occur, measured from the cable axis, and this series is represented by the curve in Fig. 3 :

TABLE II.

Per cent. of Sheath Ele'tion.	Horizontal Distance from axis.		Per cent. of Sheath Ele'tion.	Horizontal Distance from axis.		Per cent. of Sheath Ele'tion.	Horizontal Distance from axis.	
	Cms.	Cable Diams.		Cms.	Cable Diams.		Cms.	Cable Diams.
95	3.15	0.63	60	14.58	2.9	25	71.2	14.2
90	3.92	0.784	55	18.16	3.6	20	91.8	18.4
85	4.88	0.976	50	22.65	4.5	15	121.5	24.3
80	6.07	1.21	45	28.28	5.6	10	169.1	33.8
75	7.55	1.5	40	35.38	7.1	5	269.6	53.9
70	9.40	1.8	35	44.38	8.9			
65	11.71	2.3	30	56.0	11.2			

These entries and diagrams, by representing a dimensional system of common occurrence in practice, may enable temperature elevations at different distances from an active cable determinable in some cases by direct inspection. The data, however, for constructing the diagram corresponding to Fig. 2, appropriate to any given case, are provided in Appendix II.

In this case, if the temperature elevation at the cable sheathing should be 10° C., and a second cable should be placed in the same trench, and parallel to the first at an interaxial distance of 22.7 cms., the table and curves show that the second cable would have its temperature raised by 50% of that at the sheath of the first, namely 5° C., and if 25° C. constituted the limiting safe temperature elevation above normal, then the limit of self-elevation allowed to the second cable would be reduced to twenty degrees. The same process might be extended to any number of cables buried in one trench. A diagram could be prepared showing the relative positions of the cables, and the elevation of any one would be the sum of the elevation due to all the remaining active cables taken in turn as though each acted alone. This sum would represent for that cable the total elevation above normal due to mutual influence, and should be subtracted from the range of self-elevation in assigning the limiting current strength. This proceeding not only involves the previous assumption that the temperature elevation of the ground surface is negligible, but also that the insertion of parallel idle cables into an otherwise homogeneous environment does not affect the thermal distribution previously existing. This could, of course, be only true for cables of infinitesimally small cross-section. The

Digitized by Google

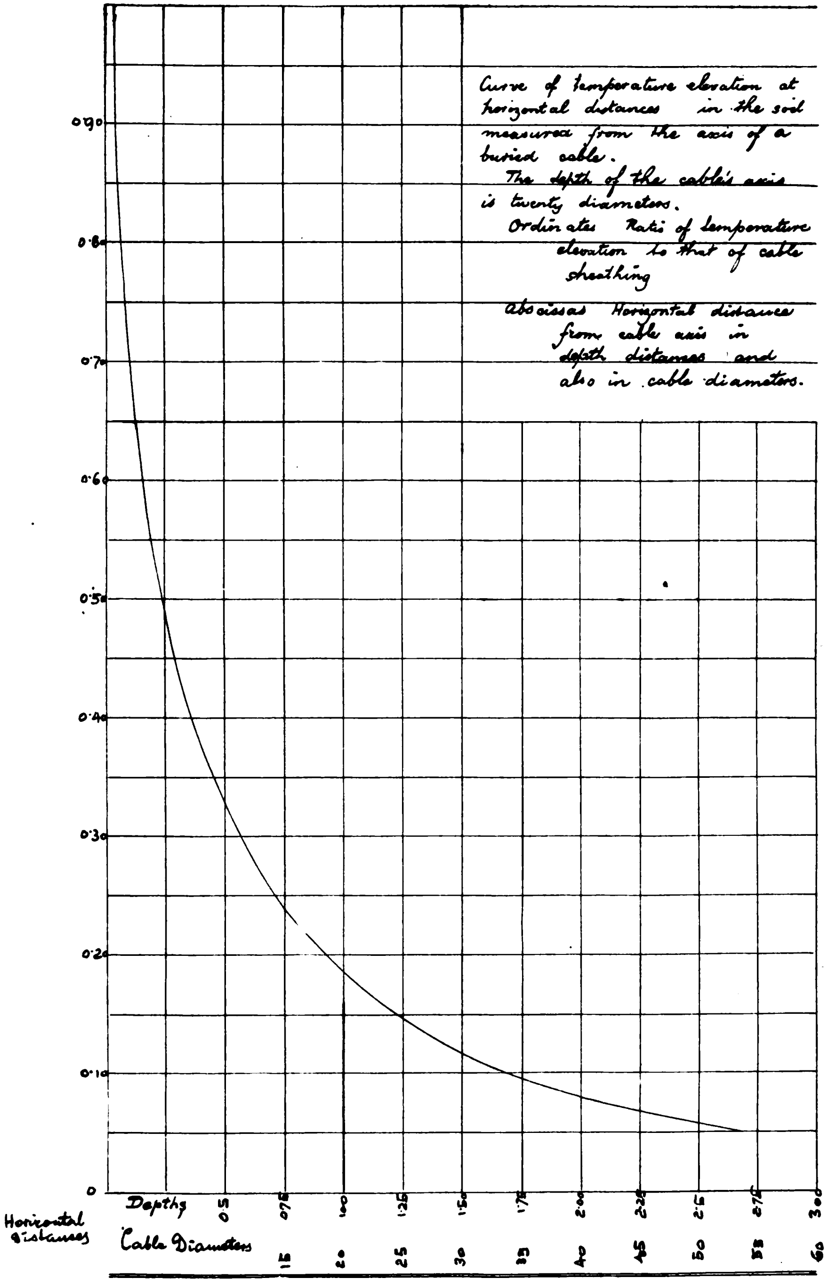


Fig: 3.

Digitized by Google

effect of the location of a sheathed cable in the vicinity of other active ones must be to equalise the temperature throughout the space it occupies, and this tendency must exert a disturbing influence, diminishing with distance, over all parts of the thermal field of distribution. The nearer the cables are packed together, and the greater the ratio of their diameters to their depths, the greater will be the discrepancy due to both these incorrect assumptions, but it would seem that for ordinary sizes, depths of from 60 to 120 cms. (2 to 4 feet), and distance apart of 30 to 90 cms. (1 to 3 feet), this error will not be serious. Observations made on cables horizontally, separated by 11.4 diameters in the same trench, showed that the temperature of one kept inactive, acquired in three hours 38% of the temperature elevation at the sheath of its active neighbor, the calculated elevation being 42%.

Fig 3 shows that for the depth there considered, the temperature elevation at a horizontal distance of twenty diameters is less than 20%, while at five diameters it is nearly 50% of that at the sheath of a continuously active cable. With heavy cables maintained for long periods of load in soils of high thermal resistivity, their distance apart in the trench may thus become an important matter.

Influence of Duration of Load upon Temperature Elevation.

The temperature elevation of a cable, with a given steady current, in the sense ordinarily intended, is that maximum elevation which is only attained after an indefinitely long period of activity. The problem of the temperature development throughout time, in and round a buried cable, may be solved on the postulate of a constant normal temperature of the ground surface, by considering two equal and parallel cables in the same vertical plane, and at a distance apart of twice the trench depth, but with the ground now distributed round them for an indefinite distance in all directions. If the lower cable generates heat at a given rate, and the upper cable absorbs (or generates negative heat) at the same rate, the temperature of the midplane between them, corresponding to the actual surface of the ground, must remain by symmetry undisturbed, and the distribution of temperature below this plane, due to the independent temperature distributions from both cables, advancing with time, will, in algebraic sum, correspond to the distribution developed by the actual cable. The problem, therefore, reverts to that of determining the distribution of temperature in an indefinitely extended medium surrounding a long straight cable steadily supplying heat, and the materials for the solution of this case have been snpplied by Fourier. It would appear that under practical conditions, the temperature elevation in and near the cable tends to reach its maximum with comparative rapidity, the approximation to the final state being more tardy as the distance from the cable increases. In the measurement of the temperature elevation of buried samples, the elevation of sizes up to 200,000 circular mils (1.014 sq. cms.) appeared to attain 95% of their full value in the conductor within twenty minutes, and the increase became inappreciable

Digitized by Google

after one hour. On the other hand while, as already remarked, a parallel idle cable 11.4 diameters horizontally distant, reached 38% of the active cable's sheath temperature, in three hours, out of 42% calculated; another idle cable, at 22.8 diameters, appeared to reach only 17% out of a calculated 29% in the same period, a discrepancy that may well have been due to time lag. It may, therefore, be safe to infer that the conductor of a buried cable will closely approximate to its ultimate temperature elevation in one hour of steady load, but there can be little doubt that many hours will be needed to establish an equal approximation to the final state, at a distance of say forty diameters from the cable.

Carrying Capacity of Cables in Air.

Although the condition of an active cable supported in air is only a special case of the general heating of aerial conductors, it yet merits separate consideration, owing to the comparatively high thermal resistance of the insulating covering in such cables, and the leading influence of this resistance upon the carrying capacity.

The current strength that will elevate the temperature of the conductor θ° C. when supported horizontally in air is $C = \sqrt{\dfrac{\theta}{\rho\left(S + \frac{1}{\varepsilon}\right)}}$ . . (11)

where ε is the total emission of heat from the external surface per linear centimetre, by convection, radiation, and wind, per degree centigrade of temperature elevation there existing. As the temperature elevation of the sheath will in practice be less than 20°C., ε may be taken as constant within that range, and as being expressed by the equation

$$\varepsilon = 0.00111 \times O + 0.00175 \quad . \; . \; . \; . \; . \; . \; . \; . \; . \quad (12)$$

where the first term on the right hand refers to the radiation, O being the external circumference in cms., and the second term to convection. The cable is supposed to be supported in still air. These constants appear to satisfy the observations very fairly. Also $\frac{1}{\varepsilon}$ may be regarded as the equivalent thermal resistance of the air round the cable under these circumstances, corresponding to the resistance G of the soil in a buried cable.

Example.—The cable previously considered, instead of being buried is supported in still air. Required the limiting current. Here O = 3.23, and $\varepsilon = 0.005335$, $\frac{1}{\varepsilon} = 187.4$.

The total thermal resistance is 81.36 + 187.4=268.76.

$$\text{and } C = \frac{5}{\sqrt{0.000\,009417 \times 268.76}} = 99.42 \text{ amperes.}$$

It appears that $\frac{1}{\varepsilon}$ is greater than G in most cases that are likely to occur in practice (exceptions occur in heavily insulated cables), so that the thermal resistance to the escape of heat from a cable is usually less when the cable is buried than when supported in still air. Consequently the

Digitized by Google

temperature elevation will be greater in the latter case for a given current strength. Also, if a cable is first supported in the air of a vault, and then enters a trench, there will be no overheating of the buried portion by load, if it is known that the unburied portion is within the safety limits of temperature elevation, and the temperature of the sheath in the buried portion will be lower than the temperature of the sheath in the vault, assuming that the normal temperature of the soil and of the vault are equal.

Thermal Resistivities.

Comparatively few measurements have been made of the thermal resistivities of bodies. They are known to be functions of the temperature of the substance. There is also reason to believe that good heat conductors conduct better, and good heat insulators insulate better, at low temperatures,* in analogy to the electrical properties of similar materials. In the absence of better information, the resistivities taken in dealing with the cables are assumed to be constant throughout the range of temperature employed.

Appendix III. gives the computed limiting current strengths of Siemens' cables, as manufactured in 1892 at the Schenectady Works, from measurements of the dimensions of samples, and from the constants arrived at by measurement and alluded to above.

APPENDIX I.—Particulars of Measurements made on Sample Siemens Cables.

Four samples of Siemens cable, each about thirty feet long, were employed, viz. : No. 12 B. & S., No. 6 B. & S., 80,000 cir. mils, and 200,000 cir. mils. The two last had stranded conductors. The insulator was jute, soaked in special compound. The sheath was a cold rolled leaden tube fitting over the insulator. Each cable was tested three times, once in flowing water, once supported in still air, and once buried in the ground. In the first test the cable occupied an iron pipe 880 cms. long, and 3.3 cms. internal, 4.1 cms. external diameter, resting upon the ground on a slight incline. Short right angle pieces were attached vertically to the ends of the pipe, and water was kept flowing through this pipe, with sufficient velocity to maintain the temperature of the water within one degree centigrade at ingress and egress. The mean of the water temperature at the two ends was assumed to coincide with the mean temperature of the sheathing. Measured currents were delivered through the cable, and the resistance of the conductor measured by differential galvanometer in comparison with a platinoid standard. The increase of resistance in the conductor covered by the pipe, gave by Matthiessen's table of temperature coefficients, the temperature elevation of the copper. The electrical connections were practically the same as those described and illustrated in the report upon the heating of

*Professor Forbes, l. c., also Everitt's Units and Physical Constants, Article "Heat."

Digitized by Google

conductors submitted at the Convention of Edison Illuminating Companies at Niagara Falls, in August, 1889. From these temperature elevations, measured current strengths, and the dimensions of the cable, the thermal resistivity of the insulating material was determined.

In the second test the cable was supported in still air, the remaining conditions being otherwise unchanged. The temperature of the sheath was measured with thermometers as a check upon the computed values.

In the third test, all four tables were buried at a depth of 76 cms. in sandy soil, and parallel to each other in the same trench, the axes of adjacent pairs being 16 cms. distant. The length of each cable resting on the bottom of the trench was 720 cms., 90 cms. being required at each end for the ascent to the surface of the ground. Pressure wires were soldered to the conductor at the upward bends, so that only the resistance of the length at the full depth was measured. The same method of testing was employed throughout. The approximation to final temperature elevation was rapid in the water-covered samples, the increase in resistance with a given current being almost inappreciable after fifteen minutes application. It was somewhat delayed in the tests in air, twenty-five minutes being generally required, and, with the buried samples, readings continued to advance until forty or fifty minutes after application of load.

APPENDIX II.—Data for Constructing a Diagram of Isothermal Surface Sections.

Let D be the depth of the cable's axis in cms.

R " the external radius of the cable sheathing (cms).

y " the depth of the axis of an isothermal cylinder (cms).

x " the distance at which the isothermal cylinder intersects the horizontal plane through the cable axis (cms).

a " the radius of the isothermal cylinder (cms).

v " the ratio of the temperature on the isothermal to the temperature at the external surface of the cable.

Then

$$a = \frac{2DB}{B^2 - 1}$$

$$y = D\frac{B^2 + 1}{B^2 - 1}$$

$$x = \frac{2D}{\sqrt{B^2 - 1}} \qquad \text{where } B = \varepsilon^{v \log_\varepsilon \left(\frac{2D}{R} - 1\right)}$$

Example :—D = 100, R = 5. Find the isothermal of half sheath temperature elevation or v = 0.5.

Here $B = \varepsilon^{0.5 \log_\varepsilon 79} = 8.888$

$a = 22.79$ cms.

$y = 102.6$ cms.

$x = 22.65$ cms.

Digitized by Google

APPENDIX III.

COMPUTED SAFE CARRYING CAPACITY OF STANDARD SIEMENS CABLES MANUFACTURED AT SCHENECTADY WORKS IN 1892.

SIZE.	C. L.			C. L. A.			C. L. A W.			C. L. A. I.			C. L. A. I. W.		
	Water.	Soil.	Air.	Water.	Soil.	Air.	Water.	Soil.	Air.	Water.	Soil.	Air.	Water.	Soil.	Air.
	AMPERES.			AMPERES.			AMPERES.			AMPERES			AMPERES.		
1,000,000	1580	1120	830	1280	910	800	.....	.....	.....	1160	820	800	.....	.....	.....
800,000	1630	1150	710	1140	810	700	.....	.....	.....	1070	760	700	.....	.....	.....
600,000	.....	.....	.....	.....	.....	.....	.....	.....	.....	860	600	590	820	580	620
500,000	1060	750	510	770	550	480	.....	.....	.....	760	540	510	690	490	530
400,000	1010	710	490	860	610	450	.....	.....	.....	680	480	520	630	450	490
350,000	900	640	450	670	470	410	.....	.....	.....	630	440	440	600	430	480
250,000	740	530	350	540	380	340	.....	.....	.....	520	370	350	460	330	360
200,000	640	450	300	460	320	290	.....	.....	.....	440	310	300	380	270	300
180,000	490	350	260	420	300	260	.....	.....	.....	370	260	260	370	260	280
150,000	470	330	250	390	280	250	.....	.....	.....	360	260	250	320	230	260
120,000	440	310	220	340	240	220	.....	.....	.....	330	230	230	300	210	240
100,000	370	260	200	290	210	200	.....	.....	.....	280	200	200	280	200	220
80,000	300	210	170	270	190	170	.....	.....	.....	260	180	180	230	160	180
60,000	260	180	140	.....	.....	.....	.....	.....	.....	180	120	130	.....	.....	.....
50,000	220	160	140	.....	.....	.....	.....	.....	.....	180	130	130	180	130	140
4 B & S.	200	150	110	150	110	105	160	115	115	.....	.....	.....	.....	.....	.....
6 "	150	100	80	120	80	80	120	83	85	.....	.....	.....	.....	.....	.....
8 "	110	76	61	87	62	61	90	63	65	.....	.....	.....	.....	.....	.....
10 "	81	57	47	65	46	47	70	49	51	.....	.....	.....	.....	.....	.....
12 "	58	41	36	52	37	37	49	35	37	.....	.....	.....	.....	.....	.....
14 "	50	35	29	40	28	29	38	27	32	.....	.....	.....	.....	.....	.....
16 "	34	24	21	29	21	22	27	19	21	.....	.....	.....	.....	.....	.....

In reference to the above table, it may be pointed out that additional carrying capacity of a cable when in water over that it possesses when in air, can seldom be availed of for the reason that a cable passing through water will usually have at least a short length in air or soil, which portion would become overheated if the length in water were worked to full capacity.

For the buried cables, a temperature elevation of 12.50° at the sheathing surface has been allowed.

Digitized by Google

On motion the paper was received by the Association, ordered spread in full upon the Minutes, and the hearty thanks of the Association tendered Mr. Kennelly for his very able preparation of this interesting and important addition to his classical paper presented to this Association at the Niagara Falls Meeting, which has become recognized universally as authority on this subject.

Mr. Carpenter on Rheostats.

MR. GREENE: The General Electric Company have, for some months past, been investigating the matter of rheostats, starting devices for motors, and apparatus of this kind, and, knowing that the Carpenter people were getting out what promised to be a very good thing in the way of starting apparatus and rheostats for Central Stations, together with a number of heating appliances, we arranged with them to make for us some of these rheostats. After our engineers had gone over them and tested them, we found they were not such as we would put into our own machines. Then we had them go ahead and get some rheostats with a special view to our use, and they were so successful in this that, at the present time, we have gone so far as to tell all our central station people to use Carpenter Rheostats on all stationary motors of 2, 3 and 5 H. P. Thinking possibly some of the gentlemen here might not have seen some of this apparatus, it was suggested that Mr. Carpenter come to Chicago, and (if the Association saw fit to allow him to come before it) show them some of his apparatus. He has come out for that purpose, and, I think, at the proper time, the Association could listen to him with profit, as, I believe, his apparatus is going to be very much used, and especially in the heating line. I believe that his apparatus also offers a very profitable field for additional day loads on central stations.

THE PRESIDENT: I will say, in connection with Mr. Greene's remarks, that the subject Mr. Carpenter wishes to take up seems to be in harmony with Mr. Stieringer's paper, and with what Captain Brophy has said on Fire Insurance matters, and Mr. Barker on Gas and Electric Light organizations.

MR. CARPENTER: I shall be compelled to disappoint you, perhaps happily, after what the Chairman has said, to the effect that I was to read a paper. I came here to have nothing to say, except that I might explain to you and show you something which you may be called upon to use later on, to a greater or less extent.

A short time ago I was in Boston, and had occasion to go to Mr. Edgar's Station. I learned there, while talking with one man, that he had never heard of this rheostat before, and Mr. Edgar, while he had heard of it, he understood it was very expensive to purchase. Thinking that Mr. Edgar

Digitized by Google

was as well-informed, perhaps, as any one else in this Association as to the merits of the apparatus that is being put upon the market at different times, and, in view of the fact that the General Company has adopted this apparatus for use with their bi-polar machines and generators up to and including five K. W., I thought it would be perhaps a wise thing to come before you, taking up as little of your time as possible, and bring this apparatus to your attention.

I was only able to bring four styles of field rheostats that we are manufacturing, and one sample of motor-starting rheostat of small capacity. For the benefit of those who are not familiar with the construction of these devices, I will simply say, it is constructed upon the principle that a small conductor may be placed in intimate mechanical contact with a body composed of metal and some fair heat-conducting substance, and thus have its carrying capacity for current enormously increased. You are, most of you, perhaps all of you, aware of that, and, in this construction, it can be increased about ten times that of an ordinary coil rheostat, *i. e.*, where you would put ten amperes through this, an ordinary coil rheostat that is placed in a wooden box would only be capable of safely carrying two, possibly one, ampere. The same thing applies to motor starting rheostats.

The construction of the apparatus is that we take a plate of iron and treat that to a good coat of enamel. The first coat of enamel is of different quality and fused at a different temperature from the subsequent coats which I will describe. It is fused upon the plate at a temperature of about 1700° Fahr., and, after that, the wire is placed upon the plate. (I hoped to be able to distribute some of our catalogues, showing this apparatus, but they did not arrive.) The wire is of a "zig-zag" type. This "zig-zag" type is principally to avoid the injurious effects of the linear expansion of the resistance wire, which is liable to crack the enamel, due to heat; so, by having this zig-zag, or in a cramped or staggering form, the current is distributed equally. For a wire of No. 4 Browne & Sharpe gauge, if run for two inches in one direction, would break the enamel at perhaps one-half of the current that it would take to break the enamel if the wire was cramped in loops, as we call them, not over ¼" long. After the wire is laid upon the plate in position, it is treated to two or more coats (depending upon the thickness of the wire) of what we call glass coat enamel, which is practically the same material as the first coat, except for the ingredients we put in to take the brittleness out of it. We cover up the wire entirely, so that none is exposed to oxidization

I was first going to demonstrate the durability of this apparatus, but, before doing so, it might be well for me to say something to you about its operation with heating apparatus. For some time my experiments were first taken up in making electric heating and cooking attachments in that line. We found that the plate could be made nearly red-hot without materially injuring the rheostat, and, in that case, a rheostat could certainly be made commercially successful, as it could be made durable for not over 300° Fahr.; in fact we do not make any to be used over 300° Fahr.

In the manufacture of starting rheostats, the wires are enamelled to the

Digitized by Google

surface (indicating) of the plate, and the coils or resistance portion ends in little copper terminals, which are folded over, and the copper is crushed about the resistance wire; and, where the connection is made with the copper, it is all embedded in the enamel, so that the joint is not exposed to the air, and consequently cannot oxidize. This terminal is brought out further and led through a hole in the iron, and secured fast, and it is insulated from the iron itself. The switchboard I do not need to describe.

The General Electric Co., in taking up this apparatus, did not think we had allowed sufficient margin for safety, and, while we had been making a nnmber of rheostats for various purposes, and had had very few accidents in that line, they desired to have something in which the limit of safety was much greater.

In a rheostat, which is made for starting a 1 KW. 220 volt motor, the General Company have specified that apparatus made for this purpose should have a plate 9 x 9, instead of 5 x 5½, as this gives a larger margin of safety with the same resistance and capacity. The rheostat which we have been making for starting a 1 KW., and for starting a 2 and 2½ KW., is made on a plate 12 x 12. That also includes 3 KW. capacity, which has, heretofore, been made on a plate 7 x 7; so you see the capacity of our apparatus as constructed for them has been doubled right through, which, of course, insures the safety of starting rheostats. It enables us to put double the current through them for a longer time, and also in the field rheostats, on such apparatus as is used for continuous service, it reduces the temperature.

Now we are manufacturing at present four sizes of rheostats, as you see. One is 15″ in diameter, and is rated from 60 to 80 KW., with 10 amperes passing through; one rated from 20 to 45 KW. The one 10″ in diameter ranges from 12 to 20, and the smaller one from 1 KW. up to 6 and 8 KW. We are at present carrying them in stock – one rheostat to cover different capacities of machines, with different resistances but different capacities, so that we do not need to have a number of different sized plates for a long range of different capacities of machines.

Referring to Theatre Dimming Rheostats, we have had occasion to manufacture quite a number of them, and we have now about five different kinds. This comes along the line of Mr. Brophy's paper as to insurance, and his expression of the desirability of something of this kind, as it eliminates entirely the running of a lot of wires down through the floor, which are liable, if not properly protected, to result in fire. In putting them in for one theatre, especially, we used the space which the architect had allotted for the switches alone, and some of the wires I think carried 70 amperes. We had to put the whole thing about sixteen feet along the wall. We built up close to the switches, which were of the knife-blade type, and everything was in plain sight. The plates did not come within six inches of the woodwork, and there was nothing there to catch fire. Another illustration: We are now installing some dimmers in a theatre at Paterson, where they have found it necessary to make some repairs this summer. Our dimmers pulled the lights down to where they wanted them. The others did not work that way. One reason why they bought our apparatus, was

Digitized by Google

that it occupied such small space, and they could put it in nearly as cheaply as they could put in those other dimmers again, and at the same time have better fire protection.

I should be glad to answer any questions than anyone may raise as to the rating, durability, etc., and prices of this apparatus, for that matter.

THE SECRETARY: Is this lava insulation?

MR. CARPENTER: Yes, sir.

THE SECRETARY: What is the temperature of that wire when working at full capacity?

MR. CARPENTER: That is something which is a little hard to determine. It is, of course, in contact with an iron plate, but we do not make any apparatus for continuous duty that ranges over 250° Fahr. This is the maximum. We calculate an overload at that, but for field rheostats, we calculate them to work from 100° to exceeding 200° somewhere, with no danger of fire. We have a number of field rheostats in operation. I have taken occasion the last few weeks to visit some of the plants in which they are running, and especially at one which I visited I could almost bear my hand upon the body of the apparatus itself. Where they are used on a wooden switchboard we recommend putting a porcelain insulator in the leg.

MR. HOWELL: I think it would be well for the Association to notice the correspondence between Mr. Kennelly's views and those of Mr. Carpenter. Mr. Kennelly has shown us that wires buried in the earth or in the water have their carrying capacity increased from 50 to 100 per cent. Mr. Carpenter has shown us that wire brought in intimate contact with iron can also have its carrying capacity very greatly increased.

THE PRESIDENT: What is the relative cost of this apparatus as compared with the ordinary rheostats—take the ordinary fire-proof rheostats in use at the present time?

MR. CARPENTER: We have never manufactured anything of that kind, but I have been told by one or two companies who used our apparatus considerably that they found, to get the same result, the price of our apparatus compared very favorably with that of other apparatus; that they had found the others so much more cumbersome, and, everything considered, ours was really one-half the cost of other apparatus.

THE PRESIDENT: That is a very important point.

MR. GREENE: I should like to say that the General Electric Company, in looking into this matter some time ago, had taken into account primarily the question of cost, which, as you say, is a very important matter for a central station, or for an isolated plant for that matter, thinking if the mechanical and electrical feature of the apparatus were equal to the present apparatus it would certainly be expensive. We found, in looking into it, that the matter of cost was very much in favor of this class of apparatus. You will see it is very compact. I have seen an isolated plant installed where it was an impossibility to put in the old wooden box. The passageway was not of sufficient size to admit of putting the ordinary apparatus in. I believe also that this method is going to make the apparatus much more

Digitized by Google

fire-proof than any heretofore used. With the ordinary apparatus a great amount of space is taken up by the boxes, from which you are liable to have a fire and, if anything happens to the building, the cables themselves are liable to catch on fire. When our engineers looked into the matter they found the only point they were required to consider was that of whether the margin of safety was such as to warrant our using them. We have been using Mr. Carpenter's apparatus, as he says, giving excellent results, and, for new apparatus, remarkably little trouble. We found them so compact and the cost was so small that we could afford to increase the margin of safety, so in determining the sizes for use in bi-polar machines and for stations, up to and including 5 H. P., we have, in some cases, doubled the capacity of the normal or standard sizes. You can get some idea of the cost of these from the catalogue, which Mr. Carpenter will give you, containing a list of prices, and you will find that he will be able to quote a discount of 50 per cent. to the licensee companies of this list. The Carpenter Company has been selling ordinary companies 30 per cent. off and construction companies 40 per cent. off. Of course these prices they are making now are based on the cost of a small number of rheostats. If the business increases, as we certainly expect it will, and orders are placed in lots of fifty or more, we shall expect the cost to come down, and it probably will come down.

I should like to ask Captain Brophy's opinion of the value of this apparatus in reducing fires in stations or isolated plants.

Mr. Brophy: If there is anything that will give an insurance man the "night-mare" it is these wooden resistance boxes placed in a theatre. (Laughter.) Some time or other they are going to raise mischief with the people who own the station and to the owners of the theatre, and perhaps something more serious to the audience, in the course of time. I am glad to welcome anything that will abolish this device. I have been in Mr. Carpenter's factory, and I became quite familiar with the method of manufacture as carried out in his apparatus. He was not then making rheostats, but was making apparatus for heating purposes. I can see no difficulty in mounting his rheostats on a wooden switchboard, or on a wooden wall, for that matter, as long as we get rid of the cables, many of which are inflammable, and when a fire starts in any portion of the building they tend to spread it. So that, with this apparatus, we get rid of a great many complications which add to the hazards in the ordinary resistances attached to the rheostats.

The President: I think we have reason to congratulate ourselves on the advance made in this direction. I see before me a number of gentlemen who will require resistances put out by the General Edison Electric Company. It is found that Mr. Carpenter's apparatus takes up comparatively little room, and when we consider that, with the ordinary apparatus, it is necessary to take up all the available space, and sometimes to even build a small room to put the rheostat in, this, you will see, is a very important point. We have reason to congratulate ourselves, therefore, on the very great advance this company has made, and, on behalf of the Association, I

Digitized by Google

desire to extend thanks to Mr. Carpenter for having brought to our attention in such a convincing way, so that it seems to me there can be no two opinions as to the desirability of adopting this apparatus. I have had occasion in the past to place rheostats in theatres, and realized that I was taking up nearly all of their space.

MR. GREENE: I want to say that we do not mean to stop testing and experimenting in this direction. We are now carrying out experiments in connection with Mr. Carpenter, upon his advice and suggestion, with large multi-polar machines and with motors of large capacity, and I think it is only the question of a little time when we will throw away our old style of rheostats entirely and adopt these, but we do not want to do that until we are assured that this new apparatus will be a success.

On motion of Mr. Post, adjourned to 2 P. M.

Digitized by Google

THIRD SESSION.

The Third Session convened at the Wisconsin State Building, August 9th, at 2 P. M., President John I. Beggs in the chair.

Mr. Barstow's Paper.

The Secretary then read the following paper by Mr. W. S. Barstow, on "Description and Test of the Third District Station of the Edison Electric Illuminating Company of Brooklyn."

Description and Test of the Third District Station of the Edison Electric Illuminating Company of Brooklyn, by W. S. Barstow.

Some four years ago Mr. C. J. Field read before this Association a paper on the "Latest Developments in Edison Central Station Practice in Brooklyn, N. Y.," having in mind at that time the First District Station of the Company. This station was laid out with 3,000 h. p. capacity, ample, it was then thought, to provide for at least five years' requirements. The Fall of '89, at the starting of the station, saw an equivalent of 6,000 16 c. p. lamps connected, and since then the progress has been :

Fall of 1889	6,000
Fall of 1890	25,172
Fall of 1891	41,379
Fall of 1892	75,450

The last connection is made up of:

42,782 incandescent,
1,778 arc,
1,042 h. p. motors.

In order to keep up with this four years increase, it was necessary to watch carefully central station construction, so that when a time came for quick action, it would not be necessary to indulge in temporary work, which is so detrimental to the funds of any company.

During this time (of four years) three new stations have been built, and

Digitized by Google

the original Pearl Street First District Station is now being doubled in size and quadrupled in its capacity.

Since the building of this station (described by Mr. Field), so many improvements have arisen that we find central station construction work almost revolutionized, even down to the general character of the building, changed by the return of direct connected units, and the simplification of the distributing system as far as pressure regulation is concerned.

In considering to-day the type of station that should be erected in a given territory, we must give much preliminary time in studying the local conditions before attempting to arrange the plant.

There are perhaps few places in the country where such a variety of local conditions are met with as in Brooklyn, and to give you an idea of these I have outlined a brief description.

The First District territory is one and a half miles in diameter, and has a distributing center located one block from the station. It is purely a business district.

The Second District territory is two miles in diameter, and has three distributing centers, each located four blocks from the station. It is a combination of resident and business district.

The Third District territory is two miles in diameter, and has four distributing centers, each one-half a mile from the station. It is purely a business district (of somewhat economical character).

The Fourth District territory is one mile in diameter, and has one distributing center two miles from the First District (being supplied by it). It is a residential district.

I submit at the close of this paper three load curves, which will show the character of the business in three of the different districts.

Under the above conditions we have so combined the districts by the booster and tie line system, that for the supply of the whole area we operate one station 24 hours, one station 16 hours, and one station 8 hours.

A description of the First District station was so ably given by Mr. Field that it is unnecessary to say anything beyond the fact that it has been operating four years without any change in building or machinery.

The Second District station, which for two years was simply a distributing house, was built about six months before the subject of direct connection was agitated, and so was constructed much on the same plan as the First District, except that as land was less expensive, the entire plant occupies one floor.

The Third District station, the subject of the accompanying test, was constructed last Fall, work being begun July 1st, and finally completed November 1st. In its construction we endeavored to profit by our past experience in the previous plants, and to construct the most modern station possible.

In going over the progress of central station construction for several years, I was forced to the conclusion that the most desirable thing wanted in our new plant was simplicity, with as little as possible of the 120% efficiency labor and fuel saving devices now on the market. By simplicity

Digitized by Google

I do not mean primitive construction, but the adopting of only those devices which, requiring little cost to operate, and few repairs, still leave a large margin of saving in the *financial* efficiency of the plant. This fact can only be ascertained by actual experience of ourselves or others, since there are to-day so many devices which, although showing on paper a large per cent. saving, still actually add to the inefficiency of the plant when they are put into commercial use.

On studying the characteristics of the new district, a decided peculiarity was found to exist in the distribution of business. This part of Brooklyn, called Williamsburgh, is composed of an accumulation of small business centers, about five in number, each about one-quarter of a mile in diameter and one mile apart. These centers are so arranged as to form an incomplete circle, each center being located about half a mile from the station which is built in their midst. Outside of these business centers there is little, if any, business, so that no light or power is furnished nearer than a quarter of a mile from the station. Another fact which was developed by a (T. H.) company doing business in this territory was that, owing to the character of the business in this section of Brooklyn, arc lights would prevail in our connections. To meet the requirements of this somewhat curious district there was devised a trunk-feeder system of distribution, that is a system in which a main feeder, composed of three 1,000,000 c. m. conductors, each in a separate pipe, supplies a regular distributing center consisting of its own system of feeders and mains. Thus, every one of these business centers before mentioned has its own center of distribution independent of the other, supplied directly from the station. There were two important reasons why each trunk-feeder should have all three conductors of the same size :

I.—Because of the fact that we were going to deal with a low tension arc light load which cannot be kept in perfect balance.

II.—Because of the possibility of rendering the system proof against serious break downs.

The following explanation will show more clearly this last reason :

Each trunk-feeder is fitted at either end with reversible copper links, so that the polarity of any conductor can be changed at will; thus should a ground (which must always appear before a short circuit, each conductor being in a separate pipe), occur on either outside conductor, this conductor is at midnight, or when the load is light, transposed with the neutral so as to shift the ground to the neutral polarity. During the light load both ends of this conductor are temporarily grounded, the conductor itself between the temporary grounds disconnected, the fault located and remedied, the conductor put back in its proper place and the temporary grounds removed. Thus, we can provide for all cessation of supply of current to the distributing centers. Another innovation connected with the system is the laying of telephone, or telegraph, as now used, metallic circuit lines between the iron pipe and the conductors. This, by connecting together our distributing centers and stations, makes us independent of the telephone company, whose magneto system we operate. By the use of telegraphic communica-

Digitized by Google

tion between the electrical galleries of the different plants the shifting of the load from one station to another is very neatly accomplished.

In considering the location of our Williamsburgh plant, two localities presented themselves: one on the water front, one mile from the main distributing center, and the other at the main distributing center. After every detail of investment, profit and loss was gone into, the latter location was found to possess the greater advantage. Before, however, the location was announced or land purchased, test wells were driven to ascertain the different strata. While we were sure of obtaining water anywhere in the locality, it was very important to ascertain the flow and height of water level and the kind of strata at the termination of the pipe. This last is all important, for if the water be drawn from a silt strata the fine dust would necessarily be pumped out with the water, a space finally created, and the surrounding ground settle. The strata under our present plant consists of forty feet of solid, tough blue clay, ten feet of fine sand and silt, ten feet of coarse white sand and fifteen feet of large white pebbles. These last surround the strainers of the wells and allow nothing to be pumped out but clear water. The water rises to within four feet of the condenser and the wells yield a very abundant flow.

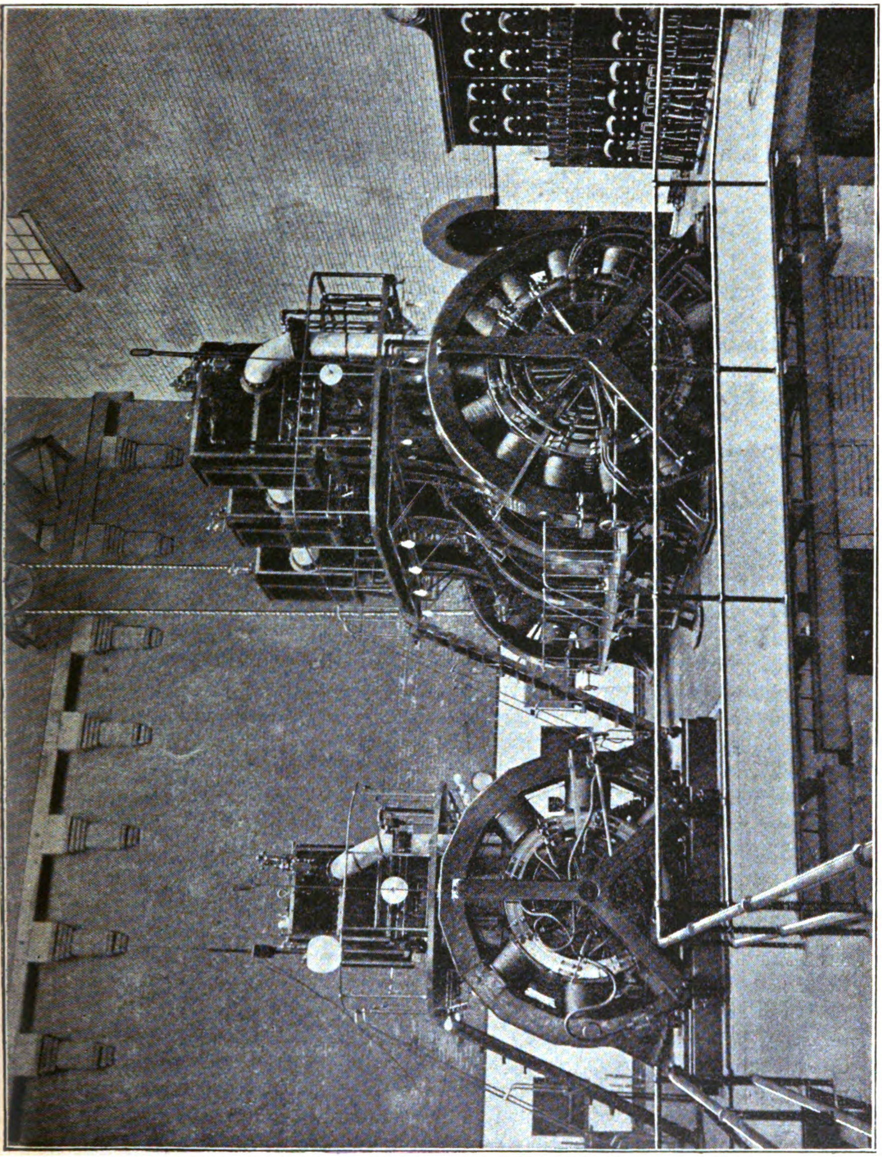
In the laying out of the new plant a departure was made from the regular practice, for in place of accommodating our machinery to the building we accommodated the building to every detail of the machinery. We further so modified our building plans that while they were made for the machinery to be installed they would also accommodate, without alterations, any make or type placed upon the market, thus allowing a wide building margin for future improvements and increase.

One of the first thoughts which come to us in the erection of a plant is the boiler pressure required for highest efficiency. This, of course, is dependent to a great degree on the type of engine used. As in our Williamsburgh plant we were enabled to use triple expansion condensing engines, our initial boiler pressure was fixed somewhere between 155 and 180 lbs. There was, however, further considered the fact that in case of a break-down in the condensing part of our plant we should be able to take care of our load, even should it be up to our capacity. With this requirement in view we designed, built, and have operated our station at 200 pounds pressure.

Special care was necessary under these high pressure conditions, in the design of piping, valves, fittings, etc. In order to reduce all loss due to condensation between the boiler and engine, all separators or devices which would expose large surface to the steam were omitted wherever possible, particular attention being paid to the dripping of the piping as well as with the expansion and contraction. All main line valves (weighing some 1,700 lbs. apiece) were centralized and this portion of the piping, weighing six tons, is securely anchored, the balance of the piping being on pipe rollers on brick piers.

After considering many of the well known types of boilers in the market, the Climax generator was decided upon as filling the requirements of high steam pressure and superheated steam. In connection with this boiler is used an inexpensive economizer. In investigating the merits of this piece of apparatus we come across an interesting fact (developed by ex-

Digitized by Google



VIEW OF ENGINE-ROOM, THIRD DISTRICT STATION, BROOKLYN, N. Y.

Digitized by Google

perience). It is found in actual practice that should water be introduced into an economizer at a temperature of less than 100° Fahrenheit the iron or brass of the economizer coils will gradually crystallize until a break occurs. This changing in the character of the metal takes from four to six years, and to prolong (in our case) the life of the economizer, a heater was introduced between the engines and condenser, the water entering the heater at about 60° and leaving at 120° before entering the economizer. Whether this will follow past experience in other places we cannot ascertain for several years to come.

Coal is furnished to and ashes taken from the boilers by a C. W. Hunt bucket conveyor, which handles without any manual labor whatever the coal and ashes of the plant.

In selection of engines nine different makers were consulted and asked to submit figures; the contract being finally awarded to the Lake Erie Engineering Works of Buffalo for one 800 H. P. for 2x200 K. W. generators, and one 400 H. P. for 2x100 K. W. The horsepower of both engines is larger than actually required by the generator, the sizes above given being chosen so that the efficiency curve of the engine might correspond to that of the generator, and at the same time allow for an overload. The condenser for the large engine is connected direct to the engine, the vertical air pump being operated from the cross-head of the low pressure piston. An independent Conover condenser is used in connection with the small engine on account of its higher speed. (A photograph of the two engines is submitted.)

The Williams engine (built by the Lake Erie Engineering Company of Buffalo) is fitted with balanced flat slide valves and is governed on the high pressure cylinder, the intermediate and low running on a fixed eccentric, or on the high and intermediate, the low running on a fixed eccentric. This change in governing is effected while the engine is running with the load on or off, by the throwing of a lever moving a link. So quietly do these engines run that I know those present who have seen them will bear me out in the assertion that a person standing ten feet from them, with his back turned, would not know they were in operation.

The switchboard, a glimpse of which can be seen in the photograph, is furnished with Weston shunt volt and ammeters and is made in sections so that additions or changes can be made to one part without disturbing the other.

The most interesting facts about central station construction always develop after the station is started or been in operation about a year, and as this fact was appreciated from past experience, we have had a test made by Prof. Denton, of Stevens Institute, showing the actual efficiency of the plant ten months after its start, and we have also accumulated a little interesting data on the comparison of this new triple-expansion-condensing-direct-connected station, with a non-condensing direct belted plant. In giving you these comparisons it might be well to add that everything has been reduced as much as possible to a like standard of comparisons, and to the actual conditions of everyday central station operation.

I beg to submit the following curves and tables with brief explanations.

Digitized by Google

ABSTRACT FROM REPORT

OF

STEVENS INSTITUTE OF TECHNOLOGY,

DEPARTMENT OF TESTS.

HOBOKEN, N. J., June 5th, 1893.

EDISON ELECTRIC ILLUMINATING CO.,

GENTLEMEN :

We have the following report to make in regard to the economy of one of the triple expansion engines in use at your station located at Gwinnett Street, Brooklyn, N. Y.

The main object of the test was to determine the steam consumption of the engine per hour per indicated horse power. In addition to this, the electrical output and the economy of the boilers were measured.

The final results of the tests on the 2 x 100 K. W. engine, averaging on a day's run each, are as follows :

Number of Test.	Boiler pressure in lbs. per square inch.	Electrical output in Watts.	Indicated horse-power of engine.	Steam per hour per indicated H. P., reduced to 26″ vacuum in lbs.	Ratio of electrical to total indicated H. P.
2	164	182,000	280.3	15.94	87.0
3	181	154,000	239.4	16.83	86.2
4*	164	135,000	213.6	16.81	84.7
5	164	78,000	128.0	20.53	81.7

*Link adjusted so that the cut-off of the intermediate cylinder was shorter than in Test No. 3.

The engine tested was built by the Lake Erie Engineering Works. The dimensions are as follows :

	Bore in inches.	Clearance in per cent. Average of two ends.
High pressure cylinder	10	23
Intermediate "	16	15
Low pressure "	25.07	9

Stroke of all pistons .... 20 inches.

Diameter of all piston-rods .... 2½ "

Digitized by Google

Another engine of similar construction to the above, but of larger dimensions, was also in operation at the station during a portion of each day. The only test made on this large engine was to determine the electrical output for various indicated horse powers, this only being continued to half the capacity of the engine, due to the fact that it could not be spared from its station duty. The results of these tests, as far as carried out, are represented by a curve. It will be seen that the ratio of the electrical output to the total indicated power is 86.2%, at a load equal to 44% of the rated capacity of the two dynamos, and decreases to 35.3% at 7% of the rated capacity.

The dimensions of the large engines are :

Bore of cylinders, 15″ x 24½″ x 38.1″.
Diameter of all piston rods, 4″.
Stroke of all pistons, 32.″

The engine on which the economy and complete tests were made drove two 100 Kilowatt Edison dynamos, which were directly connected to the main shaft. The high pressure and intermediate cylinders were furnished with jackets, which were connected directly to the steam-chest, so that the steam in them was at the pressure of the steam in the steam-chest. All the steam condensed in the jackets passed into the cylinders along with the entering steam. There were no jackets on the low pressure cylinder.

The boiler was of the Morrin Climax type, rated by the makers at 250 horse power. The coal was of the grade usually burned at the station, and called Babylon Buckwheat No. 2. A second boiler of the same size and pattern as the above was in use at the station.

The electrical power developed by the dynamos was absorbed by means of water resistance. This consisted of a wooden trough which was made to hold twenty-four iron plates, 24″ x 32″ placed six feet apart. The alternate plates were connected to the plus and minus poles of the dynamo. This arrangement did the work required of it in the most perfect manner, By preserving the water at a given height in the box, and adding a small amount of acid from time to time, the electrical readings were preserved at a perfectly uniform figure.

Method of Conducting the Tests.

One of the boilers was connected so that all the steam generated in it passed directly to the engine that was being tested. The other boiler furnished steam for the feed and vacuum pumps, and at times it also supplied steam to the large engine which carried the commercial load of the station.

The blow-off connections of the boiler that was connected to the engine on which the tests were made were disconnected so that any leak would have been apparent to the eye. The water furnished to this boiler represented the steam used by the engine.

To measure the water, two barrels were mounted over a reservoir, from

Digitized by Google

which the feed-water was pumped. These barrels were alternately filled up to an over-flow pipe and emptied into the reservoir. A party at the feed-pump ran it at such a speed that the water was preserved at a constant height in the gauge-glass. In taking a reading of the water fed, the reservoir was filled up to a given height, and the number of barrels and fraction of a barrel were recorded. To obtain the fraction of a barrel, the height of water in it was measured, and the corrections for each measurement determined at the end of the test by weighing the water required to fill the barrel to the given height. All the drips were closed during the tests, and the pipes leading from them were disconnected in order to make sure that there was no leakage.

The system of piping was so arranged that there was a valve between the two main lines which led to the engines. Any leakage at this valve would have affected the results of the test. To make certain that this valve was tight, two methods were employed. The first was to shut off all the steam from one of the pipes and allow it to cool, and meanwhile maintain the full pressure on the other pipe. Any leakage would then be shown at the drips of the cold pipe. No such leakage was found.

The second method was to run for several hours with a lower steam pressure in the pipe into which the valve opened than that acting on the engine, and then, without altering the conditions under which the engine was run, increase this pressure so that it was considerably above that acting on the engine. In one case any leakage would cause the results obtained in the engine test to be too high, and in the other they would be too low. If, therefore, the variation in pressure, as above described, did not affect the rate of steam used by the engine there could be no leakage.

There was no variation and consequently no leakage.

The pistons of all the cylinders were tested for leakage by removing the covers and admitting steam to the lower ends of the cylinders. The exhaust valves for the lower ends of the cylinders, and the admission valves for the top ends, were also tested. No serious leakage was found, and all the surface was smooth and in perfect working order.

Very respectfully,

(Signed) D S. JACOBUS, M. E.,
Asst. Prof. Experimental Mechanics.

Digitized by Google

Average Data and Results of Boiler Tests.

Morrin Climax, Boilermaker's rating of horse power = 250. Heating surface = 3,740 square feet. Grate area = 55 square feet. Ratio of heating to grate area = 68.

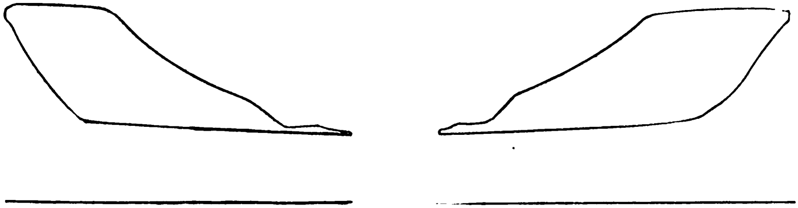
Date of Making Tests.	May 1st.	May 4th & 5th.
Duration of Test in hours	12	21
TOTAL QUANTITIES.		
Wood to start fires in lbs	340	336
Equivalent in coal at 40%	136	134
Coal burned in lbs	6,758	9,422
Coal plus equivalent of wood in lbs	6,894	9,556
Total ashes in lbs	800	1,755
Combustible in lbs	6,094	7,801
Water evaporated in lbs	52,640	70,422
AVERAGES AND PER HOUR.		
Coal per hour in lbs	574.5	455.
Per cent. of ash	11.6	18.4
Per cent. of moisture in coal	1.7	2.3
Water evaporated per hour in lbs	4,386.7	3,353.4
Steam pressure in lbs. per sq. inch above atmosphere	163.7	168.3
Superheating in degrees (Fahrenheit)	82.4	70.4
Temperature of feed water (entering heating coil)	121.2	116.4
Temperature of feed water (leaving heating coil)	174.9	170.0
RATES OF EVAPORATION.		
Per pound of coal (actual)	7.63	7.37
Per pound of coal (from and at 212 degrees Fahr.)	9.05	8.73
Per pound of combustible (actual)	8.64	9.03
Per pound of combustible (from and at 212 degrees Fahr.)	10.25	10.70
EVAPORATION PER SQUARE FOOT OF HEAT, SURFACE, ETC.		
Coal burned per square foot of grate per hour in pounds	10.40	8.3
Evaporation per square foot of heating surface per hour in lbs	1.17	0.90
Horse power on the basis recommended by the American Society of Mechanical Engineers, or 34½ lbs. per hour from and at 212 degrees Fahrenheit	150.8	115.2

Digitized by Google

FIG. 1.

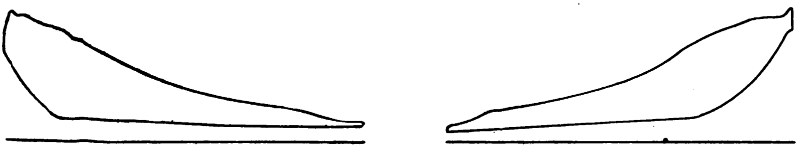
TEST No. 1. APR. 27TH '93

STEAM PER HR. PER H.P. = 17.77



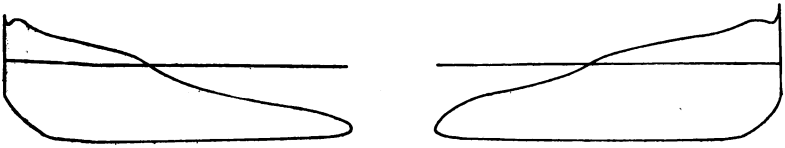
BOTTOM END SCALE = 101 TOP END SCALE = 100

CARDS OF HIGH PRESSURE CYLINDER.



BOTTOM END SCALE = 61.3 TOP END SCALE = 61.0

CARDS OF INTERMEDIATE CYLINDER.



BOTTOM END SCALE = 19.5 TOP END SCALE = 19.8

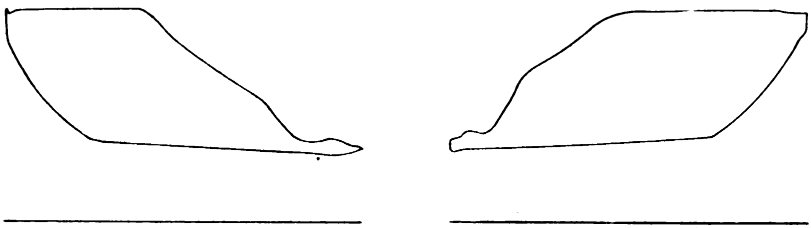
CARDS OF LOW PRESSURE CYLINDER.

Digitized by Google

FIG. 2.

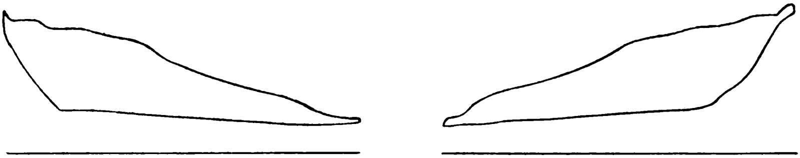
TEST No. 2. MAY 1st '93

STEAM PER HR. PER H.P. = 16.38



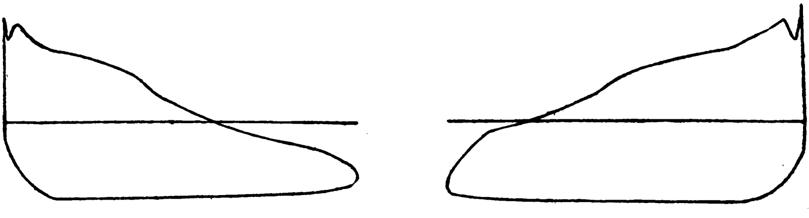
BOTTOM END SCALE = 101 TOP END SCALE = 100

CARDS OF HIGH PRESSURE CYLINDER.



BOTTOM END SCALE = 61.8 TOP END SCALE = 61.0

CARDS OF INTERMEDIATE CYLINDER.



BOTTOM END SCALE = 19.5 TOP-END SCALE = 19.8

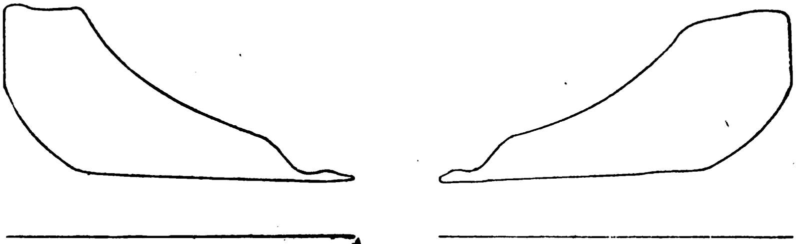
CARDS OF LOW PRESSURE CYLINDER.

Digitized by Google

FIG. 3.

TEST No. 3. MAY 4TH. '93

STEAM PER HR. PER H.P. = 17.31



BOTTOM END SCALE = 101 TOP END SCALE = 100

CARDS OF HIGH PRESSURE CYLINDER.

BOTTOM END SCALE = 61.3 TOP END SCALE = 61.0

CARDS OF INTERMEDIATE CYLINDER.

BOTTOM END SCALE = 19.5 TOP END SCALE = 19.8

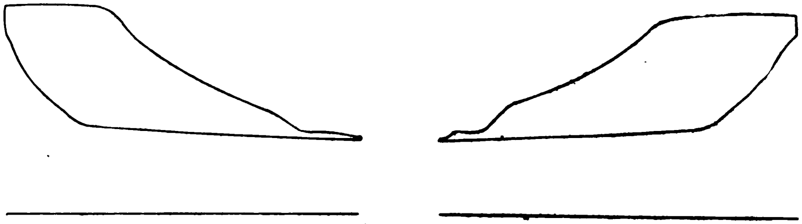
CARDS OF LOW PRESSURE CYLINDER.

Digitized by Google

FIG. 4.

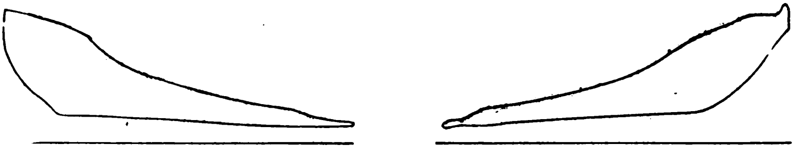
TEST No. 4. MAY 4TH '93

STEAM PER HR. PER H.P.= 17.78



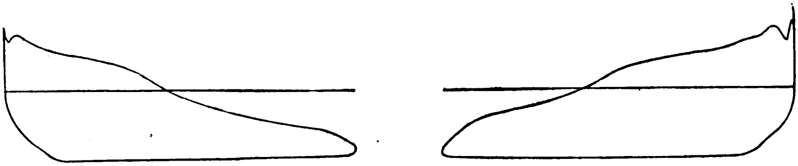
BOTTOM END SCALE=101 TOP END SCALE=100

CARDS OF HIGH PRESSURE CYLINDER.



BOTTOM END SCALE=61.8 TOP END SCALE=61.0

CARDS OF INTERMEDIATE CYLINDER.



BOTTOM END SCALE=19.5 TOP END SCALE=19.8

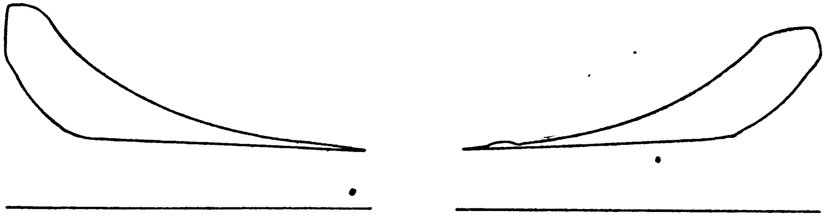
CARDS OF LOW PRESSURE CYLINDER.

Digitized by Google

FIG. 5.

TEST No. 5. MAY 4 & 5TH '93

STEAM PER HR. PER HP. = 20.68

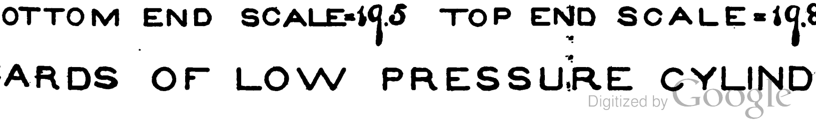


BOTTOM END SCALE=101 TOP END SCALE = 100

CARDS OF HIGH PRESSURE CYLINDER.

BOTTOM END SCALE=61.3 TOP END SCALE=61.0

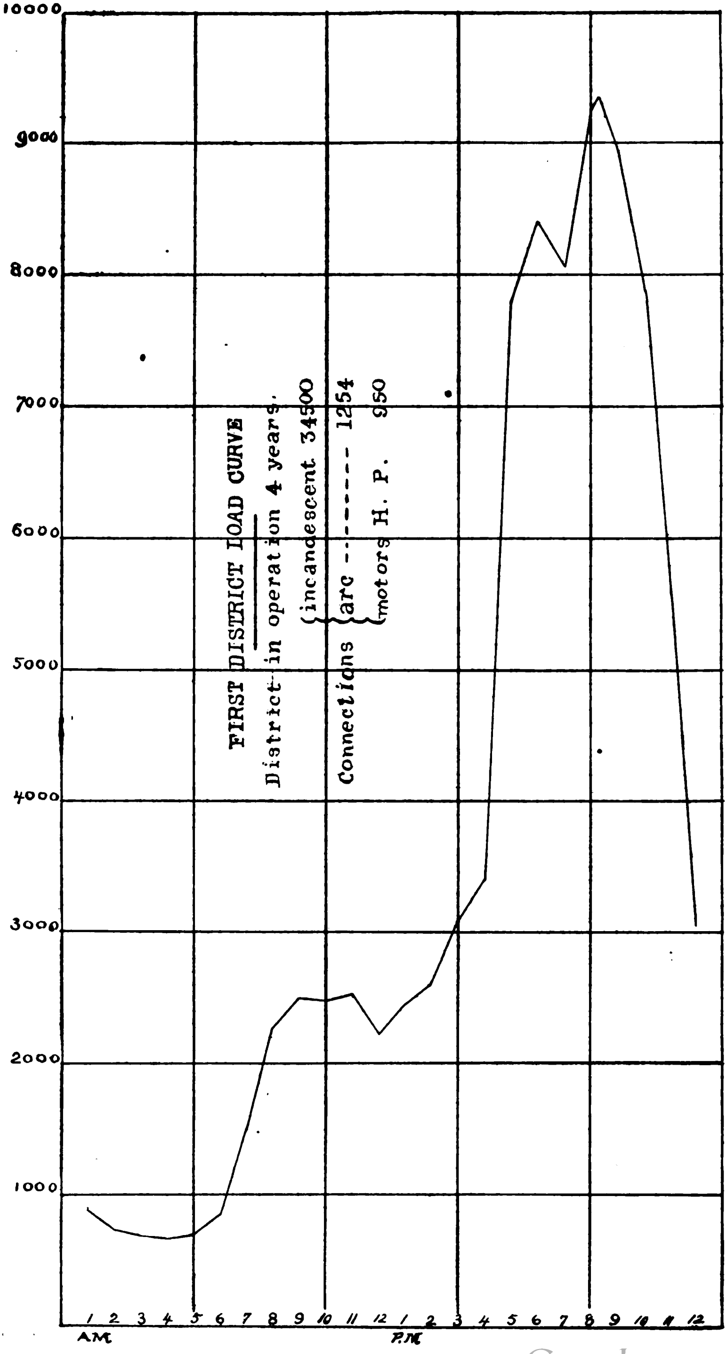
CARDS OF INTERMEDIATE CYLINDER.



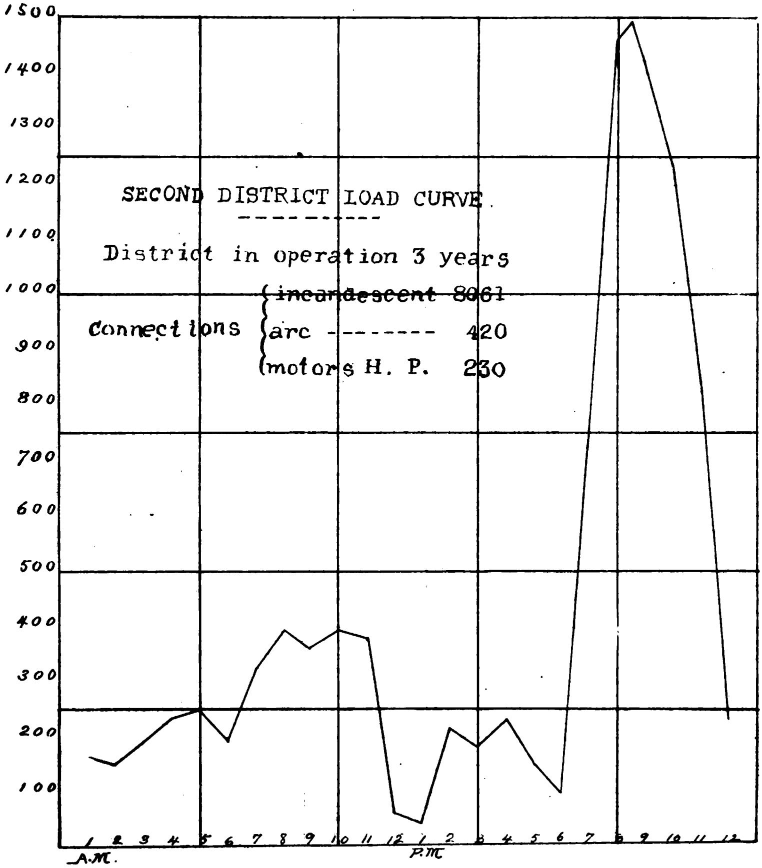
BOTTOM END SCALE=19.5 TOP END SCALE=19.8

CARDS OF LOW PRESSURE CYLINDER.

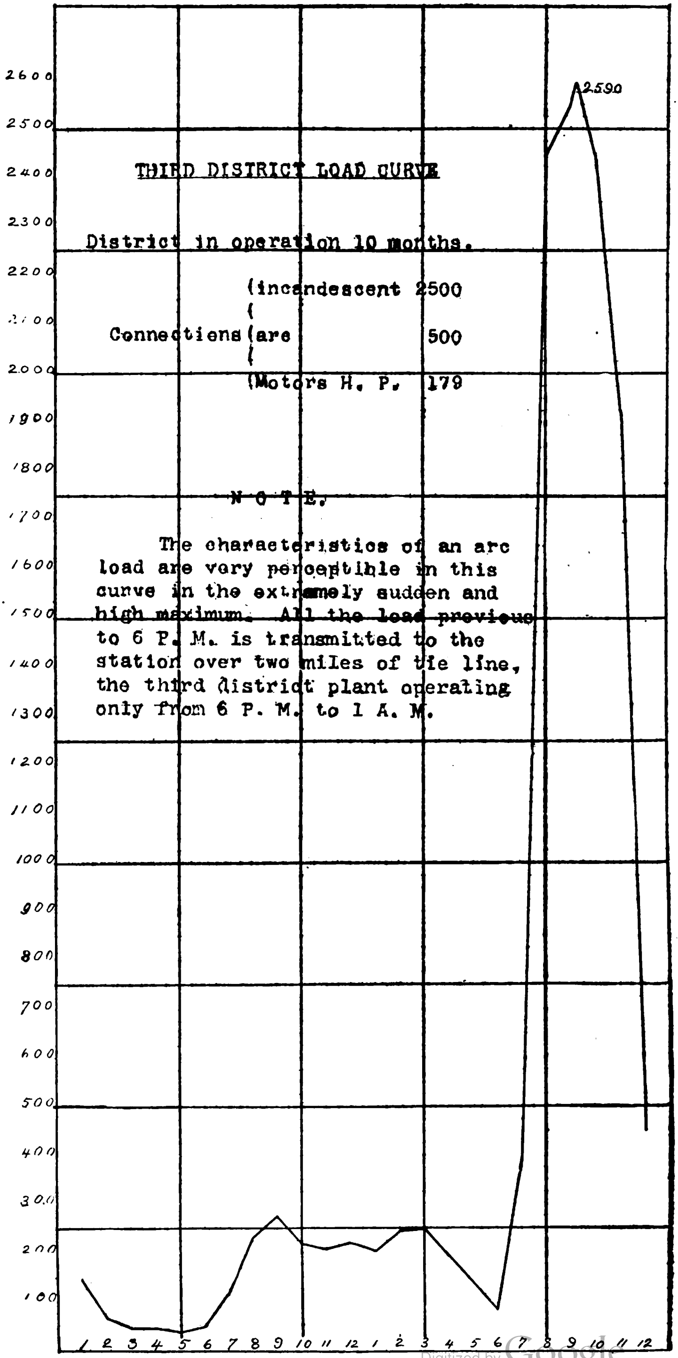
Digitized by Google



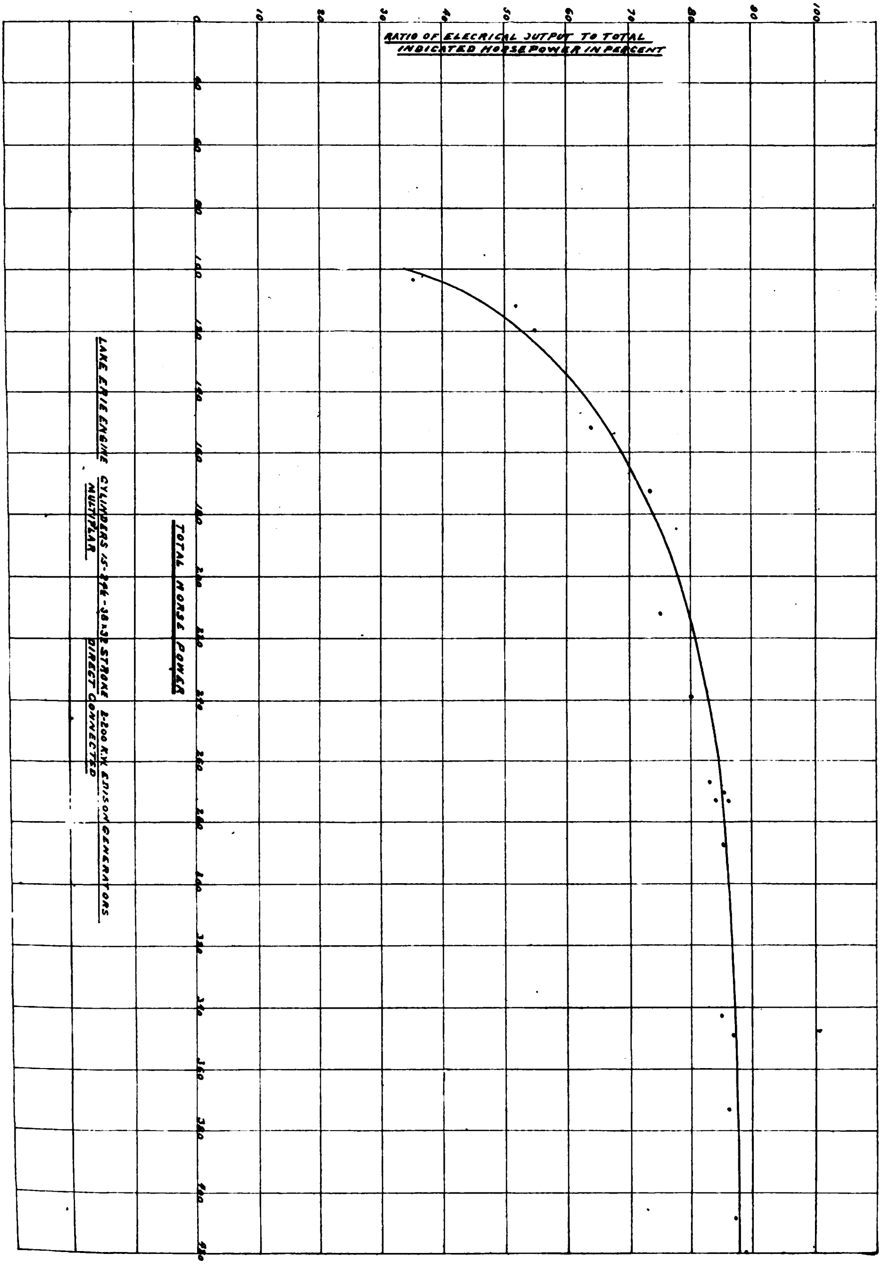
Digitized by Google

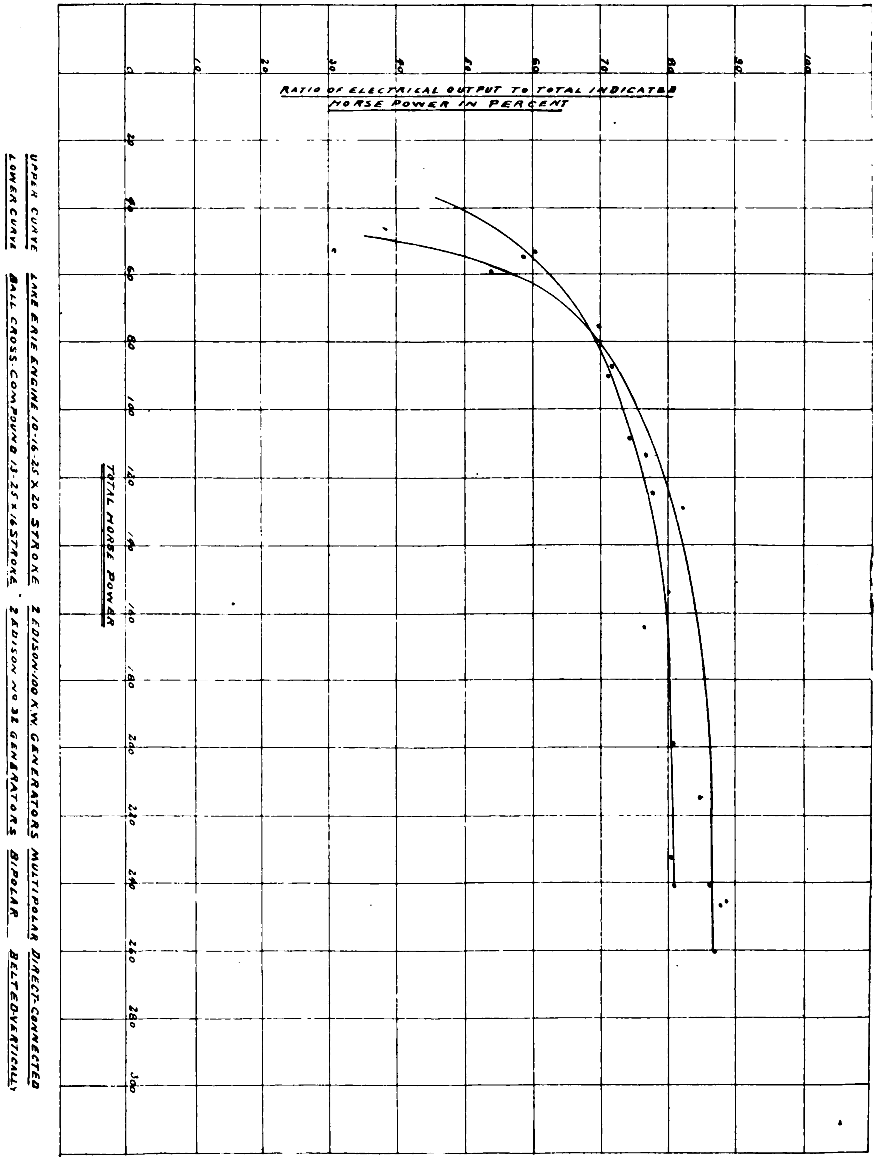


Digitized by Google



Digitized by Google


RATIO OF ELECRICAL OUTPUT TO TOTAL
INDICATED HORSEPOWER IN PERCENT
TOTAL HORSE POWER
LAKE ERIE ENGINE CYLINDERS STROKE EDISON GENERATORS
MULTIPLAR DIRECT CONNECTED


RATIO OF ELECTRICAL OUTPUT TO TOTAL INDICATED HORSE POWER IN PERCENT
0 10 20 30 40 50 60 70 80 90 100
TOTAL HORSE POWER
20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
UPPER CURVE LAKE ERIE ENGINE 10-16-25 X 20 STROKE 2 EDISON 100 K.W. GENERATORS MULTIPOLAR DIRECT-CONNECTED
LOWER CURVE BALL CROSS-COMPOUND 13-25 X 16 STROKE 2 EDISON NO 32 GENERATORS BIPOLAR BELTED-VERTICALLY

On motion, the thanks of the Association were extended to Mr. Barstow, and the paper ordered incorporated in the Minutes. It was also ordered that the Secretary have this paper printed in advance of the Minutes and issued to the members in pamphlet form.

THE PRESIDENT: I would like to call your attention to one statement in that paper. I have criticized it with the Brooklyn Company themselves, and I think it is a very material matter to central station managers who are contemplating the installation of new steam plants. I confess myself that I have been unable to understand why an engine, rated nominally at 400 H. P., with reserve capacity of at least fifty per cent. additional horse-power, should be connected to two 100 K. W. generators. It seems to me a great waste, and that it would be no credit to an engine of that capacity to walk off with a load of 200 K. W. I made this criticism at the time of the Brooklyn meeting, and I repeat it here. If I were building a plant, I would much prefer to connect two 200 K. W. generators to an engine of 400 H. P. capacity, and I would have machines connected to it by which I would be able to get the maximum outcome of current with minimum space at the station and highest economy of steam plant.

Election of Officers.

THE PRESIDENT: It has been customary to appoint a committee to nominate officers and an executive committee for the ensuing year. If there is no objection on the part of the Association, the Chair will announce that committee at this time, in order that they may have time to confer and prepare their report. There being no objection, I will appoint as this committee: Mr. A. L. Smith, of Appleton, Wis.; Mr. A. W. Field, of Columbus, O.; Mr. J. P. Dickson, of Scranton, Pa.

In this connection, I desire to say, as outlined in my brief remarks made yesterday in opening, that I thoroughly appreciate the long-continued patience and the long-contined indulgence and confidence of this Association in the years that I have been its President, but I desire to say to this committee that I am in no sense open for nomination to this office.

The Committee subsequently reported as follows:

MR. SMITH: The duty and responsibility of making the nominations of officers of this Association for another term having fallen upon the committeee of which I am chairman, I beg to say that, after due and deliberate consideration, we have decided upon the following nominations:

President, C. L. Edgar, General Manager of the Edison Electric Illuminating Company of Boston.

Digitized by Google

Vice-President, Geo. H. Finn, Secretary of the Edison Electric Light & Power Company, St. Paul.

Secretary, W. S. Barstow, Gen. Supt. Edison Electric Illuminating Co. of Brooklyn.

Treasurer, Mr. Wilson S. Howell.

For members of the Executive Committee, Messrs. John I. Beggs, C. P. Gilbert, E. R. Weeks, W. D. Marks and Jas. W. Pryor.

On motion of Mr. Post, the report of the Committee was adopted, and the Secretary directed to cast the ballot for the Association. This having been done, the members nominated were declared by the Chair duly elected.

MR. BEGGS: In connection with this there naturally comes a feeling—I cannot say just of sadness, as we are not parting company, but there has been much of pleasure, much of interest, while at times some friction, in the administration of this office. I look back upon the eight years which I have occupied it with the inward consciousness that during all that time, regardless of what my own interests might be, I have to the best of my ability tried to protect the interests of the local illuminating companies or the licensees of the parent company. I have the inward consciousness of having done that to the best of my ability. We have seen many changes in that time. Now that another gentleman has been elected to this position, I desire to bear to this Association my tribute to his fitness, and my belief in the fidelity with which he will administer the affairs of this Association. He has been faithful in season and out of season. No sacrifice of time has been too great for Mr. Edgar in serving the interests of this Association. I have known him intimately for years. I have watched his course carefully, he being a much older man in the business than I, and I now tender to him the gavel which I have wielded here for eight years. My best wishes will go with him, my earnest co-operation at all times will be extended him, and I will assist him in every way in my power to make the future administration of this office more instrumental in furthering the interests of the illuminating companies.

I thank you, gentlemen, for the very great consideration always shown me, and for the great patience which at times you have extended to me, because at times it has required patience, for those on the outside have not always seen as those have who have been on the inside. I therefore doubly appreciate the confidence and good-will that I have ever received at your hands.

Now, Mr. Edgar, I ask you to come forward and assume the control of this Association.

MR. EDGAR (in taking the chair): Gentlemen, I do not feel that I care to say very much this afternoon. I am not much of a talker at any time, but I desire to thank you all very heartily. I desire to thank, personally, Mr. Beggs for his kind wishes and kind statements in my favor. I realize more thoroughly than you do that I have succeeded a man who is thoroughly

Digitized by Google

conversant with parliamentary practices. It is therefore with some little reluctance that I assume the duties of this office. Mr. Beggs has worked at all times faithfully and earnestly to protect the interests of the various illuminating companies, and has officiated as President of this Association for the past eight years, to the satisfaction of all concerned. When we come together next August, I shall be glad to make more extended remarks.

MR. WEEKS: I think some official recognition is due by this Association to the officers who have served us so ably in the past, and I would like to say that I fully concur in what Mr. Beggs has said, and would add that the best indication of the confidence of this Association has been his re-election from time to time during the past eight years.

I think, Mr. President, that we should pass, at this time, some resolution of thanks to Mr. Beggs, and also to Mr. Jenks, who at this time retires. I want to say, as simply reverting to my remarks of yesterday regarding the delay in the publication of the Minutes, that I fully appreciate the arduous labors that Mr. Jenks has had laid upon him, and I feel that it will be difficult for us to get a Secretary who will combine the many qualifications for that duty that Mr. Jenks has in the past shown. I would move you therefore, Mr. President, that the thanks of the Association be tendered to the retiring officers for their faithful and considerate regard for the interests of the Association in the past.

MR. DICKSON: In seconding that motion, I would say that this is the first meeting that I have attended of the Association. I am a member of a number of mechanical associations, and I know that a man who takes the reins of the government, in handling any association of this kind, and the man who does the work of a secretary of an asssociation of this kind, cannot be too fitly thanked, because that is about all the pay he gets. His pay is usually like the Irishman's pay, too, mostly in kicks, and the kicks come before the thanks generally. It has been the source of great pleasure to me to come here to this meeting and see what this Association is doing. The success of the Association is apparent to all, and the reason of that success is, I think, largely due to Mr. Beggs, the retiring President, and to Mr. Jenks, the retiring Secretary, and it gives me more pleasure than I can say to second the resolution that has just been offered.

Motion was unanimously carried.

MR. BEGGS: I have already said all that I can possibly say. I thoroughly appreciate the kindly manner in which Mr. Weeks and Mr. Dickson have taken occasion to present this resolution for your consideration.

MR. JENKS: Gentlemen, I cannot say what I feel in surrendering the books and papers of the Association to a man who will make a thoughtful and very worthy representative of the illuminating companies in all the little details which go to make up the Secretary's work. Mr. Barstow will have my heartiest co-operation. He will be sufficiently near to me to enable

Digitized by Google

us to consult at times, as may be required, until he thoroughly gets the run of the Secretary's work, which is really a somewhat of an arduous task in the course of a year. The preparation of the Minutes, which the gentlemen of the Association see more of than anything else, is perhaps as small as any one part of the work of the Secretary. I am very glad to see the position assumed by a member with whom I can so heartily co-operate, and who will be so acceptable to the Association. It is four years since I succeeded Mr. Vail in this position, and in all that time I have not had an unkind word from any member of the Association. I know that at times I have seemed to be dilatory. Perhaps many of you who know me best will realize that this has been simply seeming, and not real. My best wishes go with Mr. Barstow in the work which he takes up.

The Sale of Lamps in Licensed Territory.

MR. WEEKS : I would like to refer to a matter which came up yesterday and ask Mr. Pryor to answer a question in regard to the lamp case. It was reported by the papers quite widely that, in the case of an isolated plant in New York, the apparatus for which was sold prior to the first decision of Judge Wallace in the lamp case, application had been made to the Edison licensee in that territory who refused to sell them such lamps as they needed for renewal. Is there anything in that report? That report is being spread quite widely by our competitors to our detriment.

MR. PRYOR : The case that Mr. Weeks refers to is the Holland House, I suppose. That plant was, I believe, installed before Judge Wallace's decision. The theory of the prosecution in these cases in which the illuminating companies are directly concerned is that the interests of an illuminating company as a licensee is somewhat different from the interests of the parent company, and, in all of the infringement cases which have directly involved the rights of any licensee, the theory has been that, so far as the territory for which the licensee has paid good value is concerned, the licensee (being the owner of the patent for that territory) has the right to refuse to sell lamps in any particular case, or to refuse to sell lamps except upon such conditions and at such prices as they may see fit, in their judgment, to impose. I suppose it is the radical theory of patents on the one side that no mere public use can give to other than the patentee any rights whatever under the patent, and that it is absolutely his and he can do what he pleases with it. So far as these New York cases have progressed, the dictum of Judge Lacombe has strongly indicated that this is the theory in these cases.

The course that the New York Company may pursue in regard to customers, or those who desire to become customers, must depend upon the legal rights which each has in the matter. That company is very desirous of having its legal rights decided in court, and it is thought that the way to have that done most quickly is to go to the extreme and stand upon the rights of the patentee, or the rights of the licensee, who, in some respects,

Digitized by Google

may have more rights than the patentee, because he has paid good value for the rights in his territory. So that the report is true, and that is the situation in New York.

MR. WEEKS: It is claimed that, under the decree of the Court of Appeals upholding the Edison patent, the right is given the defendant at any time to come in and pray for the annulment of the decree upon the refusal of an Edison plant to sell lamps for use in connection with apparatus purchased prior to the decision of Judge Wallace. I would like very much to hear what Mr. Fish might have to say on that point, as it is a very vital one.

MR. GREENE: I think that Mr. Weeks gets rather too narrow a view of the decision of the Court of Appeals. That decision gave to the defendants the right to move for the suspension or modification of the injunction upon proof of specific instances of refusal on the part of the plaintiff to supply lamps under the patent sustained, upon terms reasonable under the circumstances of the particular case, and it might be that the illuminating company would be perfectly justified in taking the stand that it would be unreasonable to sell lamps to certain parties under any conditions. As Mr. Pryor says, this is an extreme case. From what I have heard from our counsel, we have of course kept ourselves posted on this particular case, it certainly looks as if Judge Lacombe stood with the illuminating company's absolute rights as owner of the patent in that territory, and that they were going to be fully sustained. And, coming from a judge fully conversant with the case in that part of the country, it will be a guide-mark and precedent for other courts. I think the vital point in the decision of the Court of Appeals was that each individual case should be taken up and passed upon from the standpoint of that particular case.

MR. BEGGS: I think that Mr. Greene's suggestion that the view of the court is very clearly outlined in that decision is quite right, and that decision is directing to a certain extent the action of one company, which is very much interested in what might be ruling of the courts on that point. I refer to the Harrisburg Company, to which I referred yesterday. Of course, in this matter, the court no doubt felt that it did not care to exercise all the power it had, and go so far as to say the case should not be reopened. Any one, as you know, might pray for any kind of relief or restraint, but whether the court would consider it is another matter.

Referring to the New York cases, the Imperial Hotel was, I think, installed before the Holland House—the Imperial Hotel some three or four years ago, and the Holland House not until since that time. The New York Company, who felt vindictive at the time, said: "We will not sell you lamps, and we will make you pay the usual rate for current, not being governed in the least by the large amount of current which you might consume."

I will say, in reference to the Harrisburg Company, that that company has run under the contract system up to the present year, notwithstanding I myself have, for several years, advocated a different basis. I do not think the Harrisburg Company has been receiving as much as 3/8c. for a 16 c. p.

Digitized by Google

lamp an hour from a certain hotel which they were supplying. This hotel was paying us about $200 a month for 400 lamps, running about thirty hours a day. That may seem a little absurd, but it comes very nearly being true. The lamps were never turned out, and, when 16 c. p. lamps would have been ample, they insisted on 32s, 24s, 20s, and all that. Now, we have made a proposition to that hotel to supply them current, and the Harrisburg Company has, within the last six months, contracted for 800 Thomson-Houston Recording Watt Meters at an expense of $17,000, in order that we may furnish our 800 and odd customers current upon the meter basis. We have established a rate that we thought would not be unreasonable or unfair. This is a rate of 3/4c., which would be equivalent to $1.50 for gas. We have laid out a sliding scale, giving on a bill of $10 or under a discount of five per cent.; on bills between $10 and $20, a discount of ten per cent.; on bills between $20 and $50, a discount of fifteen per cent.; bills between $50 and $75, twenty per cent.; and from $75 to $100, a discount of twenty-five per cent. A large number of consumers we offered a discount of one-third off, or, in other words, 1/2c. for a 16 c. p. lamp per hour, or upon the basis of gas at $1.00 a thousand. We wanted to make the rate so fair that they would not feel that we were attempting to extort a large price out of them because of the advantage of the position we held. At the same time, since the Harrisburg Company adopted that policy, our revenues, if they have not increased, they certainly have not decreased. I believe they will be increased forty per cent. as far as lamp renewals, etc., go, and, as less apparatus is required to run, and the force in the station will not be so much occupied, they will be able to give their attention to other work. Now, if we had, in the spirit of vindictiveness, made that hotel come from a contract basis of $200 a month to 1 1/8 or 1 1/4c. an hour, they, having installed their plant prior to the decision of Judge Wallace, might have thought this entitled them to relief. Under the broad terms of that decision, any plant installed since that time is not entitled to relief, and, consequently, must suffer all the consequences the local illuminating company chooses to visit upon them. Therefore, it seems that each one of these cases should be brought up. But, in the case of the Harrisburg Company, we feel that some large central station has been supplying these people with Edison lamps. They have not attempted to start it up, but, to show their defiance to the Harrisburg Electric Light Company, and their independence of it, they have put lamps in our sockets—Edison lamps of their own—to show that they are absolutely independent, and they say that they are guaranteed in their investment. We tried very hard to persuade them not to put in a plant, as it will cost them $500 a month, if it cost them one cent's worth, for which we were being paid $200 a month, but the directors could not very well be prevailed upon. Rather than have any transaction with us, they will permit themselves to be imposed upon. This is a type of what the Harrisburg Station has to contend with.

As I said yesterday, what the companies now have to do is to throw around themselves greater safeguards and secure their rights under the contract made with the parent company. Now, some one is responsible for

Digitized by Google

the violation of that contract, and it would seem to me that it will probably be necessary (I throw this out as a suggestion), for the lamp companies to put on some initial letter on the New York lamps. I do not know that any lamps have escaped from that territory, and I have no reason to believe that they have allowed their carefulness to relax in this respect. Nevertheless, it is from these large companies that buy lamps by tens of thousands (and I once had the pleasure of giving an order for 50,000 lamps as General Manager of the New York Company) that the lamps get outside of the territory. I cannot, of course, tell where these lamps are coming from. With these little plants who have 400 or 500 lights, it is an easy matter to trace and see if there is any leak going on, and to know when the lamps escape, but the trouble lies with these large companies where it is not an uncommon thing to order from 10 to 50,000 lamps at a time. The letter "C" might be placed on the lamps for Chicago, "N. Y." on those for New York and "B" on those for Boston. I have put a detective on the case at Harrisburg. I knew if we could get the number of any one of the packages we could trace it. The lamp factories know every package. They would know whose hands it passed through when it was shipped and to whom it was shipped, as it would have to go out of one of our several district offices. It is a very easy matter to trace this if you can get the number of the package of lamps, or the number on the barrel or cask. It would not take five minutes to tell how these lamps got into the territory. If we had "N. Y.," "C." or "B." placed on the lamps for large consumers, there would be no trouble at all in running this thing down. If the district officers are watchful, they can readily tell when an isolated plant has got an unusual number of lamps. I do not believe there is any way in which the lamps are so liable to get out of the licensee's territory as through those big companies.

THE PRESIDENT: I know of one company in Boston alone who have bought enough lamps to run them for three years, or until the expiration of the patent. I happen to know that they came from a large Edison station. I have no doubt that thousands of these lamps are sent out all over the United States from the various central stations, and this brings up the question of bad faith. There are, undoubtedly, illuminating companies who are intentionally selling lamps outside of their territory, and if we were to take any steps to detect them in this, they would be very careful not to have any number on the case or mark to show where they came from.

In this connection, I understand there is a committee appointed who were requested to report on the question of lamp orders. Mr. Dickinson, I believe, is chairman of that committee.

MR. PRYOR: I had a little talk with Mr. Fish yesterday, and he has drawn up a form of letter, billhead and lamp order, but I think the committee ought to meet before we make a report to the Association. The general idea that Mr. Fish and I agreed upon in consultation with Mr. Greene as to this report, was that no final report ought to be submitted, as it is a very difficult and delicate matter, and we ought to get up a form and have a number of copies distributed among the members and have them

Digitized by Google

offer suggestions after consulting our counsel about it. I think the committee would deprecate the adoption of any particular form at this time.

THE PRESIDENT: I think it might be well to hear from Mr. Greene, of the General Electric Company, on this matter.

MR. GREENE: I do not see why some form might not be gotten up for lamp orders, and I do not see any trouble in lettering the lamps, except it might happen at times something like this: suppose the New York people wanted 10,000 lamps and we had only 5,000 New York lamps in stock. I think they would yell pretty loud if we should say to them, "We haven't 10,000 of your lamps in stock, but we have 5,000 B's which would be shipped to you to suit your circuits, but they are not your lamps." I do not see how it would be possible to make an absolute ruling in that respect, but I think something of that kind might be arranged.

Now, as far as this would present difficulties in the manufacture of the lamps, I do not profess to know anything about it, and I should like to have some of our lamp men say something about it. I can say this, that I would be very glad to take it up with the lamp factory and see how a plan could be worked out and submit a report to the Executive Committee in the matter.

THE PRESIDENT: I think it is possible that the illuminating companies could do the marking themselves, if it is not practicable for the factory to do this.

MR. J. W. HOWELL: There is very little trouble connected with placing a mark on the base of a lamp, but the difficulty in doing anything like that is this: When we make lamps, we finish them, clean them and wrap them and put them in packages with the candle-power and voltage marked on the packages. We do not know, of course, where they are going. We could not mark the lamps in this case until the orders came in, and that would necessitate taking the lamps out of the packages, unwrapping them and packing them over again. That is the trouble with doing anything of that kind. Simply making the mark is nothing. We cannot carry our stock unfinished, *i. e.*, not cleaned and not wrapped up. It would get dirty, and much time would be taken up in getting the lamps in shape, and greater delays would be occasioned in filling orders. And, in filling orders, we must have the lamps ready to ship. After an order has been received, if it is necessary to unwrap the lamps and make a mark on them, it would be considerable trouble and expense. Also, connected with the expense of unwrapping and wrapping the lamps over again, would be the item of breakage, which would be quite a material one.

THE PRESIDENT: Would it not be possible to number the lamps consecutively by thousands, or something of that kind?

MR. HOWELL: Perhaps, but that would take pretty big numbers.

MR. POST: This question is one that interests all companies, and the question where these unauthorized lamps come from is a question of a good deal of importance to each company. We, in Detroit, have had considerable experience of that kind, and, in some instances, we have had occasion, from information that has come to us, to suspect, possibly, that these lamps,

Digitized by Google

instead of coming from some other illuminating company, come from the General Electric Co. Of course, I am not disposed to say anything in the way of criticism of the General Co. and its managers or officers, nor the heads of these departments, perhaps, but it comes to us so directly at second hand (I do not say that it comes first hand, but people who propose to erect isolated plants in our territory assure our customers that there is no difficulty in their obtaining these lamps from other sources, and claiming indeed that they can get these lamps from the agents of the General Co.), that this is a matter worthy of consideration. I do not mean to say that the officers of the General Co. would countenance anything of the kind, and we in Detroit have no criticism to make, for our relations with the heads of the departments of the General Electric Co. have been very agreeable and we have met with very prompt response on any complaints we have made to them, but I do not know how the agents of this company, whose compensation depends on the commission from their sales, may act towards us or towards their employers. Our information, coming at second-hand, may be at fault, but the situation certainly is this: that within a very short time two owners of buildings have installed two considerable isolated plants, and one of these will perhaps furnish current to one of its neighbors, being a competitor of ours in the nature of a central station and having obtained a large number of these Edison lamps; and another instance in our territory is that of the Union Depot, installed within a year—an isolated plant which also has a large number of Edison lamps.

Now this raises the question, of course, of the mutual obligations and duties of the local companies, and the parent company, with reference to this question. You understand, of course, that we are mutually bound to each other—the local companies not to sell lamps to go outside of the territory, and the parent company not to sell lamps to come into the territory. We, in Detroit, have taken a great deal of pains to see that there was no leak between ourselves and the customer. I have taken the matter into my own hands, to be assured that, in duty to ourselves and our parent company, no apparatus goes out of our territory.

We, as local companies, are mutually bound to each other in this respect, and we are pretty likely to take proper care in our own interest in acting toward our brother companies.

As I have stated, I do not know where these lamps come from into my territory. It does not make much difference where they did come from, we have put it in the form of a claim against the parent company for royalty, and are testing the matter along this line. We have been acting under rather peculiar circumstances in Detroit. There is the Detroit Electrical Company, that has been backed up by some large capitalists in Detroit, who are interested in some of the other large concerns in the city, and this, as you understand, supplies their customers in every direction in any one of these lines of business with which the heads of this Detroit Electrical Company are connected. The Detroit Electrical Company has apparently never had any difficulty, from some source, in supplying Edison lamps to their customers. While I say this, I will say in this connection that the

Digitized by Google

General Company has lent its aid in trying to trace this thing up, and our suspicion has been that these lamps come from some other illuminating companies, or come rather from large construction companies in Chicago; those who keep lamps for sale. However this may be, it involves the question of what are the relations of the local companies to the parent company? Of course, whether the local companies are entitled to claims against the General Company, depends on whether there is neglect or lack of attention or care on the part of the parent company in reference to this matter. It seems to me that any customer of the parent company, who has been detected in selling lamps in what is prohibited territory, ought to be blacklisted, and, as far as any agent or representative, who is detected selling directly, or indirectly, lamps to go into this prohibited territory, should be summarily dealt with. There are many ways, however, of getting around it. Any agent that is detected in aiding the introduction of lamps into prohibited territory, ought to lose his position at least. I know how difficult this sort of thing is for the parent company to manage and control. I know how difficult it is in cases where these lamps come from other illuminating companies, for them to absolutely control it. It is a matter of importance to this association, and the illuminating companies which constitute its membership, as well as to the General Company itself. It is worthy the careful attention and consideration of all, with a view of preventing these things which are operating to the detriment, of course, to both the local and the parent company, and I think this is a matter of great importance for the Association to take up.

MR. BEGGS: With our case, particularly, no label was put upon the packages, and the lamps were packed in an entirely different box, or in several boxes, and all evidence of where they came from entirely obliterated.

MR. HOWELL: They usually take the precaution to do that, but, in Detroit, where they make a business of supplying lamps generally, I think we could find the parties, because they are liable to get careless after awhile, and we could get these numbers. It is not, however, a very hard thing to make marks on the lamps.

MR. BEGGS: We know who sends them to our place. It is the National Electric Company of Eau Claire. It is supplying one station there now, and is beginning to supply an isolated plant. They secure their customers by giving them continued guarantees to supply them with the lamps. These people hesitated about six months, but it is reported now that they started up August 1st. I have no doubt that this Eau Claire Company, and a Philadelphia Engineering Company that represents them, have some source of obtaining lamps from some of the Western towns.

MR. GILBERT: I would like your views as to the responsibility of the General Electric Company concerning the matter of selling to the Eau Claire Company, provided they were advised on this point.

MR. GREENE: I think the Eau Claire Company have got their supply from some central station, based on what we were able to find out. Our Philadelphia office was investigated very carefully by Mr. Coffin, and, upon

Digitized by Google

direct orders by myself on my visit to Philadelphia, but we could not find that they had gotten any lamps from there. Then we thought possibly that they might have come from Pittsburg, from the store-rooms there, but we also found that that was not the case. It is my belief that they come from the West.

MR. BEGGS: I know the care which is now exercised to prevent lamps getting into the hands of people who ought not to have them. As Mr. Fish said, after Judge Wallace's decision, the General Electric Company withdrew the lamps from the supply houses, this being done to give local protection to the licensees. And, as Mr. Fish said yesterday, they sacrificed business that they could have had, in order that the lamps might not get into territory where there was no restriction, doing this to prevent them getting into licensees' territory. I think if we can give the General Electric Company any inkling of where the lamps are coming from, they will use the most severe methods in dealing with the guilty party, and we shall see the power that the General Company can wield over any company that has violated its contract rights. This contract is one of the strongest that could possibly be framed, and does not permit of any apparatus going beyond the territorial bounds, and I feel very positive in asserting that the General Electric Company would very severely discipline any licensee violating its contract in this manner. It means a great deal to the local companies, and far more to the General Company. Their good faith is called into account. These cases are similar to a case which arose in Dayton, Ohio, where a "straw-board" company was buying lamps in Illinois, and shipping them into the licensee's territory at that point—that company not choosing to sell them lamps. The Dayton Company simply used their rights in the matter, and would not sell them lamps at less than the absolute list rate, so the "straw-board" company was compelled to get the lamps into the territory surreptitiously, or buy them at those prices. In that case, the Dayton Company held the General Electric Company responsible.

Referring to the matter of marking lamps, no package marks or label that we could put on them would answer. It must be something that cannot be easily effaced. Mr. Edgar has suggested the consecutive numbering of the lamps. That would be a very good way, if practicable, as it would obviate the necessity of the lamp factories making up lamps for a special territory or section.

MR. HOWELL: That is, you would put these numbers on the cap of the lamp?

MR. BEGGS: I think it ought to be something a customer would not notice. Sometimes letters are blown into the glass, and I have thought that something like that might be used to check this.

In this connection I will say that no small plant can supply a concern that is putting in plants all over this country as the National Company of Eau Claire is. No small customer can do it. It must be a firm that is using lamps by the tens of thousands and by the hundreds of thousands during the course of a year, and they are doing everything they can to cover up their tracks.

Digitized by Google

Mr. Greene: This question not only is facing the illuminating companies but is facing the parent company. I have charge of the lighting contracts of the General Electric Co., and, while I admit that the General Electric Co.'s agent may sell the lamps, I will say this, that if they do sell outside of the territorial bounds, they are violating the most stringent orders from headquarters.

Mr. Gilbert: There is no question about that.

Mr. Greene: And I want to say that we are willing to press this matter, and, if we can get any evidence against any agent, or any district office that is violating these instructions, they will be disciplined in a very summary manner, for I know the feeling of the Board of our company and the active officers of the General Electric Co., and they will do everything within reason to find out where these lamps are coming from. We, as Mr. Fish said, absolutely refuse to sell apparatus to either manufacturers or construction concerns, excepting at some particular point where they could give satisfactory evidence that this apparatus was going to be used outside of licensees' territory. In these cases we would simply give them lamps enough for installation and no spare lamps.

We have 150 agents acting from our head office. It would be highly improbable that every one of these agents was so faithful that none of them would, at times, strain a point and violate our instructions, but all we can do is to try to run them down, and, if they are brought to bay, I can assure you that they will be properly dealt with.

Mr. Howell: Large railway corporations having their own plants may, as in the case of this "straw-board" company in Ohio, and any large companies having the use of plants, get their supplies through fixture concerns, or buy their lamps in one section and send them to another. While these lamps might originally come from the General Co., the General Co. would not be responsible.

Another point is brought up, that it is possible the Edison lamp may be counterfeited, and that the lamps may bear every mark of the Edison lamps and yet not be the genuine article.

Mr. Edgar: I was just going to ask whether that was practical and whether these lamps would come out in the same shape as they went in, or not. They could undoubtedly be counterfeited.

Mr. Howell: This is the first intimation that I have ever had of such a thing, but I have seen lamps that I thought were not made in our factory. I was puzzled to account for the similarity, but it has never been suggested to me that such lamps were made by others.

Mr. Gilbert: I will say that I have specimens that contain the Sawyer-Man filament, but every other element is Edison. I have laid them away as I knew they were counterfeit.

Mr. Dickinson: I would say in this connection that I am installing an isolated plant of 400 lamps, and I have letters from three different concerns offering Edison lamps cheaper than we could get them from any other company. I will let Mr. Greene have copies of these letters if he desires them. One of these comes from Ohio and one from Massachusetts.

Digitized by Google

MR. GREENE: I should like very much to have them.

THE PRESIDENT: We had a letter from the Mather Co. saying that they had more Edison lamps than they needed. That, of course, was a bluff.

MR. BEGGS: They undoubtedly wanted to get into the sale of better apparatus.

MR. HOWELL: While we are talking about lamps, I would like to ask if any member here has had any experience with repaired Edison lamps.

MR. GILBERT: In answer to that question, I would say that we have had a somewhat limited experience. We have had 200 or 250 lamps repaired by the Dennis Company, of Springfield, Mass. These lamps are running for several customers, and we are watching them, and I can see no difference in them from the other lamps as far as running is concerned. We have also had some experience with the Merritt Electrical Company, I think, of Boston. Their agent came to the office and offered to renew our Edison lamps. I finally offered him a lot of 400, which he agreed to turn at 25 cents, guaranteeing an economy of 3.5 watts per candle power, and a life of a thousand hours. Later, I received a letter from them stating that they had fears of being able to come up to the standard required. They then made me an offer on the lamps, which I declined, requesting them to either repair the lamps or return them. They finally returned them, stating that they were unable to repair them up to the Standard Edison.

THE PRESIDENT: There was a firm in Boston who claimed that they had all of their lamps repaired in this way. I referred the matter to Mr. Fish, and he says it is clearly an infringement of the Edison patent.

MR. GILBERT: One of the competing companies in Detroit have adopted the practice of getting nothing except repaired lamps.

MR. SHEDDY: I would say that I got an offer from a firm to repair our lamps at a cost of about 27 cents. I sent them 200 by express, which they returned to me in good shape.

MR. GILBERT: Did they return the same lamps?

MR. SHEDDY: Yes, sir.

MR. BEGGS: Were they marked so you were able to tell, easily, whether or not they were the same lamps, or not?

MR. SHEDDY: I have a peculiar mark so that I can tell. If they had sent others back I would know it.

MR. HOWELL: I sent away 100 lamps to the Eddy Electric Company, of Springfield, Mass., and got them back about three weeks ago. About 25 of them were Edison, and the rest were all mixed up—Sawyer-Mans, "A B C," and everything else. The lamps were spoiled in appearance. When they opened them to put in the filament, they spoiled the shape. They have now been burning two days, and look as though they had been burning six weeks. Also, the globes are not clean. They charge 18 cents a piece for them when you send 400 or more at a time. I wanted to see just how they would work, there has been so much talk about the matter.

MR. BEGGS: That is very gratifying information.

MR. BEAL: There is a matter I should like to speak of, and to know if

Digitized by Google

any other members of the Association are bothered as I am. I refer to the matter of sockets. According to our contract with the General Company, we cannot sell any sockets to go outside of our territory. During the year fully 50% of the sockets in our territory have been furnished outside of our Company. These have been bought outside largely through fixture dealers and supply houses. While it is not a matter of much loss financially, still it is a matter of annoyance, inasmuch as our company has made a ruling that we will not furnish current to any other socket but the Edison, and there are not 50 other sockets in the 50,000 to which we are supplying current. There are more Edison sockets coming from abroad than we have of our own.

MR. HOWELL : I know personally that there has been, in Philadelphia, a factory which made counterfeit Edison sockets, and that they were selling them to anybody and anywhere they could.

MR. GREENE : I also know, for a fact, of one Philadelphia Company and a Syracuse Company and others who are doing this, and suits are now pending against these. Mr. Fish said yesterday that he hoped to have most of these cases come up this fall. We picked out the Syracuse Company first, because it was the strongest financially and the most aggressive in a business way. I think we can make short work of the others when we get this Syracuse concern disposed of. I will say, as far as the General Electric Company is concerned, we have tried to use the same precaution in this respect that we have in the sale of lamps. Some years ago, the General Company tried the experiment of dealing with supply houses, and we would select for this men with certain influence among the electrical fraternity. We had a contract carefully prepared with our agents for the sale of sockets and supplies, with the provision that they should mail us monthly a statement of every socket shipped them and the disposal of same, they agreeing not to sell outside of their territory, but we abandoned this, because we found it impracticable, as we found very few of our agents who acted in good faith, and some who were acting in good faith, could not always keep their agreement. Therefore we stopped that.

MR. BEAL : The worst feature in my territory was that these sockets were put in at a price that I could not and would not sell them for. They were bought there and sold for 30 cents each in my territory, in quantities of 25 or 50. One case that came up was that of a man to whom we had sold 50 sockets at 40 cents. He brought us back 50 sockets, which, he claimed, were the ones we had sold him, bnt we knew he had procured them in another city. He claimed that, if we would make him the same price as he could procure them for elsewhere, he would pay that for the sockets—that price being 30 cents.

THE PRESIDENT : We will now listen to the report of the Committee appointed to frame and get up some sort of contract or lamp order.

Digitized by Google

Report of Committee on Contract or Lamp Order.

MR. DICKSON : The committee have had very little time in which to take this matter up, and it is one of great importance. Mr. Pryor, a member of the committee, had a talk with Mr. Fish yesterday, and we would report, as far as we have gone, and would suggest that the committee be continued in order to get any ideas that you gentlemen may have to give us, and, as soon as we can, further confer with Mr. Fish and report to the Executive Committee.

Mr. Dickson read to the Association drafts of forms which Mr. Fish had suggested in the way of letters to parties ordering lamps, and a billhead, and a form of lamp order which Mr. Pryor had thought preferable to these.

On motion of Mr. Post, the report of the Committee was accepted, and the Committee continued, with instructions to report at the next meeting of the Executive Committee.

MR. PRYOR : The members of this Committee, if the patience of the meeting will permit, would like some expression of the general opinion as to which is the best and most practical course to pursue in this lamp matter. Mr. Fish seems disposed, when an order is received for lamps, to acknowledge the receipt of same by a letter setting forth the conditions under which the order is filled, and, when a bill is rendered, have a further statement on the billhead of the conditions and understanding under which the lamps are sold. That leaves the illuminating company no formal record, except a copy of its letter, with nothing signed by the customer or proposed customer, and it leaves the letter and this rather "ferocious" billhead in the hands of the customer. Mr. Fish suggested that it would be practically impossible to get a form of this kind for lamp orders signed, but that does not seem to the Committee would be the case. The Committee thinks there would be no difficulty in getting the blank order signed before shipping the lamps, and, if this was done, we would have the order signed and in possession of the illuminating company, and the customer would have nothing in his possession to incriminate the illuminating company. Therefore, the Committee is in favor of that course. This is not exactly the kind of literature, as you know, that ought to be circulated. We would be glad to have the opinion of any member regarding this matter.

THE PRESIDENT : It seems to me that it would be very easy to get an order signed, as they are usually taken by salesmen, and the customer would be very apt not to read them at all. I fear the trouble is we are not going to reach the people we are trying to get hold of. I personally believe that ninety-nine per cent. of the lamps that get outside of the territory are sent there intentionally, and this would not touch that class of people at all.

Digitized by Google

MR. HOWELL: It seems to me that we are trying to get a remedy for a disease without knowing just what that disease is, as every one confesses ignorance as to where these lamps come from.

MR. PRYOR: I think we can assume that it is a very easy matter to get these orders signed, and that it would be preferable to adopt this method.

Stealing Central Station Current.

MR. PRYOR: There is a question that has come up in connection with the New York Company of which I wish to speak very briefly. We have discovered several people red-handed in the act of stealing current. As a result of catching them in the act, we thought that we had as good cases as we might expect. We examined the law very carefully, and this is a subject that might very well be taken up by any of these state associations that exist, or may hereafter be formed. We found that the criminal law gives no redress in the case of stealing current in this way. We, of course, have a small claim for damages, but that does not amount to much in many cases. The best legal opinion is that such stealing is not larceny. It does not seem to come under the head of larceny in New York State. There is a special law making the stealing of gas larceny, but the stealing of current is merely a misdemeanor. The rule is that the criminal statute is to be considered as strictly as possible, and if this came up in New York as a criminal case, it would be thrown out on the ground that no crime had been committed. We lose a great deal through this, because we do not feel that we can prosecute under the circumstances.

THE PRESIDENT: I think this is something very interesting to know, and I think Mr. Barker will be very much interested in this. I do not know what the law is in the State of Massachusetts on this point.

MR. BARKER: The gas companies in Massachusetts secured a law making it a criminal offense, but I do not know of any law of this kind as to the stealing of current.

MR. BEGGS: If a man could steal current in this way he would not need to make any contract.

MR. CARROLL: It seems to me that electricity would be considered a product of manufacture, and that, as such, the stealing of it would, under the statute, be a clear case of larceny. At any rate, it seems that we could well afford to test a case like that.

MR. PRYOR: You don't know the New York Legislature.

Report of the Executive Committee.

The application of Edison Light and Power Company, of San Francisco, Cal., for membership was reported as approved by the Executive Committee, and, by vote of the Association, this Company was elected a member.

Digitized by Google

The application of H. Ward Leonard & Company, of New York City, for membership was not approved, on the ground that, so far as appears by the information conveyed by their application and in the possession of the Committee, this firm is not eligible as a firm, nor is its president eligible as an individual. On motion of Mr. Post, the Secretary was instructed to advise them that this report of the Executive Committee was accepted and adopted by the Association.

THE PRESIDENT: I desire to say, in behalf of the Executive Committee, that they have worked very hard to further and protect the interests of this Association. They have had one or two meetings in the City of New York, to which Mr. Weeks came from Kansas City, Mr. Gilbert from Detroit, and Mr. Insull from Chicago. Later, a meeting was held in Chicago, and certain men came from the East here. So I desire to say a word in behalf of this Executive Committee, as their modesty prevents their doing this themselves. They have had before them, at each of these meetings, Mr. Fish to give them his views (and he could do it more fully, as he suggested himself yesterday, than he could before a full meeting of the Association), giving them all the details of the patent litigation, what was being accomplished, what was endeavored to be accomplished, and what was hoped to be accomplished. I can say that there has been no attempt at reserve of any kind at any of these meetings, and everything has been laid fully before the Committee, and I think it is due to Mr. Fish and the members of the Committee to say that they have done everything in their power to protect the interests of the Association, and, in general, of the Edison Illuminating Companies, by issuing circulars and otherwise. I, therefore, feel that just recognition is due this Committee for their labors.

I desire to say further, in behalf of the Executive Committee (of which I, as an ex-officio officer, am a member), that they would have been entitled to their travelling expenses and other necessary expenses in holding their sessions, but they have never presented any bill or made any charges against the Association. It has been borne by their respective companies, or by themselves individually. I presume the companies, however, have met this expense.

Report of Committee on Fuel Gas.

MR. EDGAR: That Committee has not had a meeting, and, so far as I know, has done nothing since the Toronto Convention.

On motion of Mr. Beggs, this committee was discharged.

Digitized by Google

Report of Committee on Prevention of Damage from Crosses With High Tension Circuits.

MR. GILBERT: After corresponding with this committee, it was found that the work was practically covered by the Committee on Lightning Protection that have already reported. As chairman of that committee, I obtained consent to leave the entire subject to them.

I might say further that the result of many inquiries in this direction show that the dangers anticipated when this Committee on Prevention of Damages from High Tension currents was named, have not been realized, or at least have not been reported. While there seems to be quite a number of theoretical dangers, practically we can account for only very few damages from this source. That is the experience so far as the report reached me. If there are any experiences contrary to that, I should be glad to hear them.

THE PRESIDENT: Do I understand you to imply that the matters that would come under this head should be incorporated with that of Lightning Protection, and taken up by that committee?

MR. GILBERT: I do.

THE PRESIDENT: It might be well to enlarge the scope of that committee and include this as part of their work.

MR. GILBERT: I would like to ask Mr. Kennelly if, in his opinion, the topic of Lightning Protection does not also cover that of Prevention of Damage from Crosses with High Tension Circuits?

MR. KENNELLY: I think, incidentally, in one or two cases the consideration of dangers from lightning may be united with the dangers from crosses with high tension circuits, but I respectfully submit the view that there are cases where crosses occur with high tension circuits that call for special consideration. I would suggest to the Association the amplification of the scope of such committee to cover the damage from high pressure of any kind, whether lightning or otherwise, if it is the intention toward the committee to take that course.

THE PRESIDENT: I think the proper course would be, when we appoint the committee, to enlarge the scope of the committee and enlarge the committee at the same time.

On motion the report of the Committee on Prevention of Damage from Crosses with High Tension Circuits was received, and the committee discharged with the thanks of the Association for its labors.

MR. BEGGS: I would like to suggest, in connection with what Mr. Kennelly has said in regard to these other two committees, that the duties of this committee might also be included with that of the Committee on Lightning Protection, and include both underground and overhead systems. It seems to me that this might be covered by the same committee, that committee being enlarged to give it greater scope.

Digitized by Google

On motion of Mr. Beggs it was moved that the Committee on Lightning Protection be broadened to include the matters that were covered by the Committee on Grounding the Neutral Wire and Crosses on High Tension Circuits, and that this committee be increased to seven members.

The Chair appointed the following members to constitute this committee: A. E. Kennelly, Wilson S. Howell, F. E. Jackson, C. P. Gilbert, W. D. Marks, H. J. Smith.

A Summary of the Goebel Defense.

MR. BEGGS: I have had handed to me by Mr. Stieringer, who usually has the best productions on electrical matters, a poem. It seems that it ought to be given a place in this meeting, following up Mr. Fish's statement yesterday in which he outlined the Goebel defense, and, with the permission of the Chair and the Association, I will read it to you and suggest that it be embalmed in the Minutes.

Lines to
HEINRICH GOEBEL,
"INVENTOR OF THE INCANDESCENT LAMP." (?)
By L. H. Latimer.

—o—

Gods! that a man like this should live
Beneath Columbia's sky,
All these long years in secrecy,
Hid from each prying eye;
Unknown, unsung, unpraised of men,
While warring factions rage—
Forgetful that his mind conceived
The wonder of the age.
Nor he alone; but all who'd seen
The triumph of his skill,
Equally they forgetful were,
And would remain so still,
Had not some legal leader's eye
Espied them from afar,
And, with the magic of his will,
Brought them to Justice's bar.
Oh, memory! thy ways profound
In voiceless awe we see,
And, wandering 'mid a maze of doubt,
Mistake a lie for thee.

Digitized by Google

Mr. Beggs (continuing): I understand that one of the attorneys stated that he would have presented this in lieu of his argument had he known of it, and he says that it would have covered the whole case. It is apparently a sort of reverie by Mr. Latimer, one of Mr. Jenks' assistants, who is one of the old-timers in the lamp industry, and who has been engaged in the lamp litigation.

Courtesies Acknowledged.

The President: There are a number of companies and a number of persons from whom we have received courtesies—the Ferris Wheel, the Ice Railroad, the Wisconsin Commissioners and Mr. A. L. Smith, the American Institute, and the General Electric Co. I think we should show our marked appreciation for the courtesies which have been extended to us while here.

On motion of Mr. Gilbert the thanks of the Association were unanimously tendered to the concerns and individuals who had done so much to add to the entertainment of the members of the Association, and a special vote of thanks was extended to Mr. A. L. Smith individually for his efforts in this behalf.

The Place of Meeting in 1894.

The President: The arranging of a place of meeting for next year will have to be settled. Coming from Boston, I desire to tender an invitation to meet there next August, and I should be glad to hear from any one else on this point.

Mr. Beggs: I move that the invitation be acccepted, and the thanks of the Association tendered Mr. Edgar of the Boston Company. A pleasanter place for meeting could hardly be found than in Boston at this season of the year. I therefore move that the place of the meeting, of August, 1894, be in the City of Boston.

The motion was seconded by Mr. Gilbert.

Mr. Greene: I simply want to say that the General Electric Company will be only too glad to have the meeting held in Boston next year. We hope to have the Association visit the works at Lynn, which, I think, may be of interest to many of you, and, at that time, there will be other matters in and around Boston which will also be of interest.

The President: I will say that Mr. Fish rather stole my thunder in extending his invitation of yesterday. I wrote Mr. Coffin a letter on the matter, and received his reply, very heartily seconding the suggestion that the Association be invited to make Boston their next place of meeting.

Digitized by Google

We are now installing one of the largest storage batteries in the United States, and that will be running during the coming winter, so that by next August we will be able to determine whether it is a success financially, and what the definite results are. I think that many members of the Association would like to visit Boston at that time.

The motion to make Boston the next place of meeting was unanimously carried.

Final Adjournment.

MR. BEGGS: I would like to impress upon the members not to relax their efforts to bring in all the Edison Illuminating Companies into our Association. I do not believe it possible if they send a representative here, such as they ought to send, without his going away very thoroughly impressed. We ought to have every Edison Company in the country in this Association. Instead of having 50 companies, we ought to have nearly 100, and I suggest that the members or companies, as they come in contact with these people, strongly impress upon them the advantage of connecting themselves with this organization.

At 4 o'clock P. M., on motion of Mr. Weeks, the meeting adjourned, subject to the call of the Executive Committee, at a time and place designated by them in Boston next year.

Evening Entertainment.

In response to an invitation of Mr. Greene and Mr. Spencer, on behalf of the General Electric Company, a considerable number of delegates met at the power station of the Intramural Railroad, which was inspected in detail. Those who arrived in season to take advantage of the afternoon sun were grouped in front of the large engine and power generator referred to in Mr. Stieringer's paper, and an excellent picture was taken by the official photographer.

After looking through the car-house, the party made the tour of the road under the watchful care of Supt. W. E. Baker, and then proceeded to the Midway, where tables had been prepared in the "Old Vienna." Two hours of the most satisfactory and substantial refreshment was enlivened by the

Digitized by Google

memorable concert of the Hungarian Band, which has proved so strong an attraction during the Fair. The delegates separated at a late hour, with an enthusiastic though informal vote of thanks to the General Electric Company for the entertainment of the two evenings. Some of the features most noteworthy are described and illustrated in Appendix S, by means of which the pleasures of the occasion may be in a small measure kept in memory by those whose privilege it was to participate.

The convention was exceptionally well attended by the delegates, even in the face of the extraordinary attractions of the World's Columbian Exposition, and the courtesy and good judgment of Chairman A. Ledyard Smith in suggesting and arranging for the Wisconsin Building as the place of meeting were warmly acknowledged by all the delegates.

Respectfully submitted,

H. S. Barstow
Secretary

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

APPENDIX A.

Digitized by Google

Digitized by Google

A CENTRAL STATION MANAGER'S EXPERIENCE WITH LIGHTNING ARRESTERS.

ELGIN, ILL., Sept. 26, 1893.

Secretary of the Association of Edison Ill. Cos.:

DEAR SIR:

Your favor of the 20th is at hand.

Our street railway system covers a section of the town about five miles in diameter. The power station is at the approximate center of this system, which is quite evenly distributed on both sides of the Fox River. The sketch accompanying this letter (Fig. 1.) will give a reasonably clear idea as to the distribution of the various lines. As will be seen, the road diverges from the center of the city in eight different directions, climbing uphill in each case until the ends of the branches are reached, from 50 to 80 feet above the river level. The return circuit runs from the station to the said center where one connection is made to the rails and ground-wire and then crosses the river where another connection is made to the rails and ground-wire of the system on that side. This return circuit is run overhead from the station to the points where it makes the above connections.

This town has of late years been much troubled with electrical storms. In 1891 we had 13; in 1892 we had 32; in 1893 we had 16 up to the end of June, since which time we have had no storms of any kind.

The first year we trusted to the lighting circuit to protect our cars, but burnt-up fixtures and a badly scared public made us add Wirt arresters on our cars, and some 50 of the same kind on the poles. The fact that we burnt out three Edison No. 20 armatures, one armature at one time, and two a few days later, convinced us that our protection was inadequate.

Digitized by Google

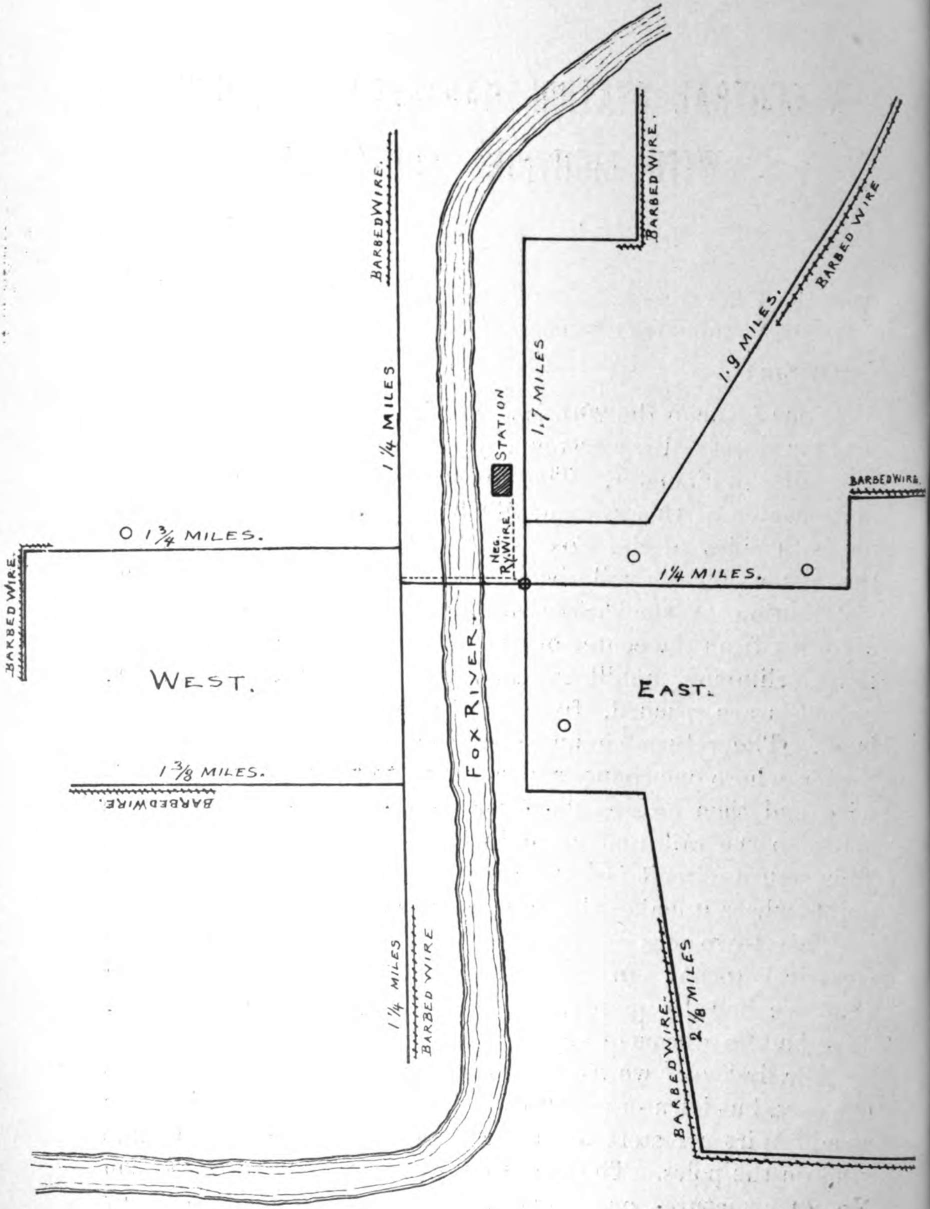


FIG. 1.

Digitized by Google

We then placed an Edison condenser arrester on each of the six railway feeders, just outside of the station, where they still remain, apparently undisturbed, as the fuse wires are in good condition. This was in 1891.

Early in 1892 we placed inside of the station six Wasson arresters, and equipped one car with an arrester of the municipal lamp cut-out pattern. The latter has proved very effective, but as the other cars suffered and it cost so much to repair the station armatures, we deemed it best to shut down the plant when the storm was at its highest.

The Edison magnetic cut-out arrester was also tried, but the resistance of the carbon was seemingly not high enough for a 500 volt circuit. The magnet did not work in any case, but an arc was formed and the belt thrown from the pullies.

Early this spring I put barbed wire over the railway wires, commencing at the ends of each branch and working towards the station, as far as trees would permit. This barbed wire was grounded at every pole by packing a coil of the grounding wire in coke buried in moist ground.

In the station I gave each feeder a few turns around a piece of 1-inch iron pipe just after it leaves the fuse cut-out, thus making a choking coil. Beyond each of these coils a Garton-Daniels arrester was placed, and another of the same type was connected to the positive bus bar, the ground connection running to the negative bus.

The station has thus the following protection :

1. Condenser arresters on feeders just outside of station.
2. Wasson arresters on feeders in station.
3. Garton-Daniels arresters on feeders in station.
4. Garton-Daniels arrester on positive bus.

With this apparatus (see Fig. 2) we have been enabled to pass through a number of storms this season without being obliged to shut down or being given any other trouble.

The Wirt arresters in the cars have been replaced by Garton-Daniels arresters, but I am unable to say how they will operate, as there have been no storms since this change was made. As said before, the air space cut-out arrester is the best and surest acting appliance of this nature to be found. It has but

Digitized by Google

one drawback, viz., that it blows the main car fuse when operated. As we are obliged to carry heavy fuses (40 ampere) on account of our long 6% and 7% grades, the short circuit is felt badly in the station and might do heavy damage. Putting in a light extra fuse will not do, as the car crew may not notice its blowing and the car would be left unprotected against a subsequent lightning discharge. I hope some satisfactory arrangement will be found by which to overcome this drawback.

But may I ask the following questions?

1. What security have we with all our arresters (with only one thirty-second of an inch air gap to ground) when one lightning discharge did not mind the arresters at all and jumped before it reached the arresters from one of the feeder wires to the negative ground-wire, a distance of about eight inches?

2. What is a good ground? Our arresters are grounded to an iron rod sunk five feet in water-carrying ground and also to the city water pipes at three different points. During a discharge through one of the arresters the fireman standing on the iron floor in front of the boiler and cleaning out the grate received such a shock as threw him on his knees.

3. A number of storms acted very queerly this year. They were noticed moving towards the city and exhibiting some very heavy lightning, but as soon as they reached the city all lightning stopped and in a few minutes the weather cleared up. Can it be that our barbed wire on the ends of the railway lines have such an effect?

In regard to our lighting plant I will say that there are fifteen Edison magnetic cut-out arresters in the station and twelve are distributed among our customers, as marked with a small circle on the sketch. These Edison cut-outs have protected us so well that we do not mind any storm. The territory covered by the lightning circuits reaches out about three-fourths of a mile in each direction from the station.

Yours very truly,

CHR. WUESTENFELD,

Manager.

Digitized by Google

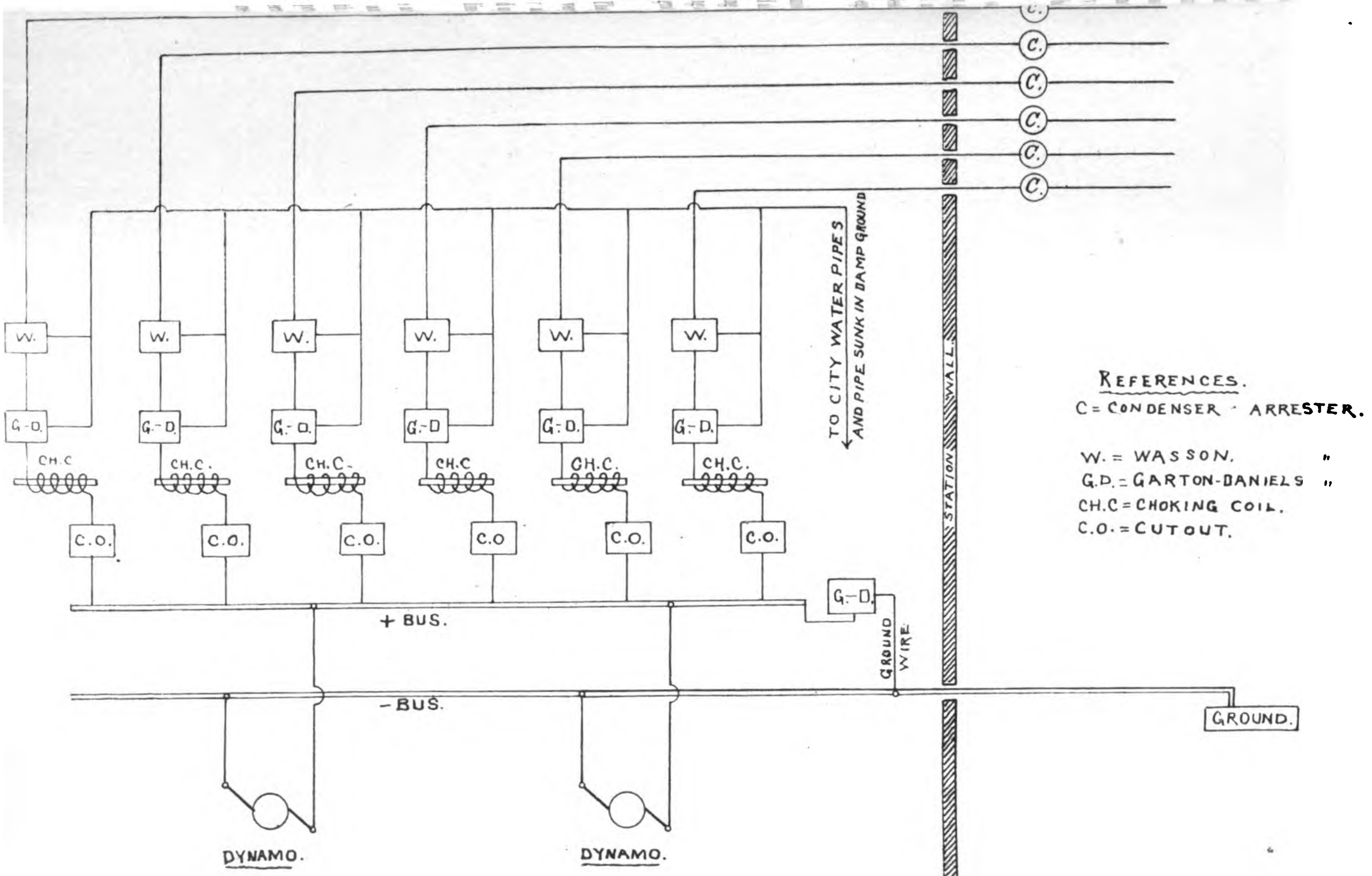


FIG. 2.

Digitized by Google

Digitized by Google

APPENDIX C.

The Edison Incandescent Lamp Case.

Full text of **Injunction Orders and Decrees** granted by the Courts against the various companies and persons sued for infringement of the Edison Lamp patent up to March 20th, 1893.

Digitized by Google

Digitized by Google

INDEX.

PAGE

The United States Electric Lightning Co.:

Decree of Circuit Court of July 23, 1891 I

" " Appellate " " October 22, 1892 IV

Sawyer-Man Electric Co.:

Decree of Circuit Court of November 19, 1892 VI

" " Appellate " " December 21, " VIII

" " Circuit " " " 23, " X

Westinghouse Electric and Manufacturing Co.:

Decree of Circuit Court of December 27, 1892 XII

The Perkins Electric Lamp Co.:

Order of Circuit Court of December 31, 1892 XIV

Decree of " " " January 6, 1893 XVIII

The Mather Electric Co.:

Order of Circuit Court of December 31, 1892 XVI

Decree of " " " January 6, 1893 XX

Illinois Electric Lamp Co.:

Order of Circuit Court of January 14, 1893 XXII

Sunbean Incandescent Lamp Co.:

Order of Circuit of January 14, 1893 XXIII

Columbia Incandescent Lamp Co.:

Order of Circuit Court of January 17, 1893 XXIV

Beacon Vacuum Pump and Elecrical Co.:

Decree of Circuit Court of February 18, 1893 XXVI

The Boston Incandescent Lamp Co.:

Decree of Circuit Court of March 17, 1893 XXVIII

The Germania Electric Co.:

Decree of Circuit Court of March 17, 1893 XXX

The Connecticut Glass Co.:

Order of Circuit Court of March 20, 1893 XXXII

Digitized by Google

Digitized by Google

Schedule A.

INTERLOCUTORY DECREE.

At a Stated Term of the Circuit Court of the United States for the Southern District of New York, in the Second Circuit, held at the United States Court Room, in the City of New York, on the 23d day of July, in the year of our Lord one thousand eight hundred and ninety-one.

Present—The Hon. William J. Wallace, Circuit Judge.

The Edison Electric Light Company, Complainant, vs. The United States Electric Lighting Company, Defendant.	In Equity, No. 3445.

This cause having been brought to a hearing on the pleadings and proofs herein, and having been argued by counsel for the respective parties,

It is, on motion of Eaton & Lewis, solicitors for the complainant, ordered, adjudged and decreed as follows:

That Letters Patent of the United States No. 223,-898, granted and issued on the 27th day of January, 1880, to Thomas A. Edison, for an improvement in electric lamps, are good and valid in law.

That Thomas A. Edison was the first and original inventor and discoverer of the said improvement as described and claimed in said letters patent, and that

Digitized by Google

the complainant The Edison Electric Light Company is the exclusive owner of said letters patent.

That the said The United States Electric Lighting Company, defendant herein, has infringed upon said letters patent, and upon the exclusive rights of the complainant under the same, by manufacturing, using and selling incandescent electric lamps embodying and containing the invention and improvement set forth in said letters patent, and particularly recited in claim 2 thereof.

And it is further ordered, adjudged and decreed that the complainant recover of the defendant the profits, gains and advantages which the defendant has received or made, or which have arisen or accrued to it from said infringement since the acquirement by complainant of title to said patent, February 12, 1880.

And also that the complainant do recover from the defendant the damages sustained by it by reason of said infringement.

And it is further ordered, adjudged and decreed that the complainant recover of the defendants its costs and charges and disbursementt in this suit, to be taxed.

And it is further ordered, adjudged and decreed, at the request of the solicitors of both parties, that it be referred to John A. Shields, one of the Masters of this Court, residing at the City of New York, to ascertain and take and state and report to the Court an account of the said profits, and also the amount of damages sustained by said complainant from said infringement.

And it is further ordered, adjudged and decreed that the complainant, on such accounting, have the right to cause an examination of the defendant, through its officers, agents and servants, *ore tenus*, or otherwise.

And also the production of the books, vouchers and documents of said defendant, and that the said defendant attend, for such purpose, before said Master from time to time, as said Master shall direct.

And it is also further ordered, adjudged and decreed

Digitized by Google

that a perpetual injunction be issued in this suit against the said defendant restraining it and its servants, agents, attorneys, workmen and employees, and each and every of them, from making, constructing, using, vending, delivering, working or putting into practice, operation or use the said invention or improvement as recited in the second claim of the said patent, or any incandescent electric lamps containing, using or employing said invention and improvement, or made in accordance therewith, or like or similar to those which it has heretofore made, used or sold, or caused to be made, used or sold, in infringement of said patent, and from in any way infringing the said second claim of said Patent No. 223,898, or the rights of the complainant under the same.

(Signed) WM. J. WALLACE.

[ENDORSED :]

United States Circuit Court, Southern District of New York. In Equity. The Edison Electric Light Company, Complainant, vs. The United States Electric Lighting Company, Defendant. Interlocutory Decree.

[FILE MARK :] U. S. Circuit Court. Filed July 23, 1891. John A. Shields, Clerk.

Digitized by Google

Schedule B.

At a Stated Term of the United States Circuit Court of Appeals for the Second Circuit, held in the Court Rooms in the City of New York, on the 4th day of October, 1892.

Present—HON. E. HENRY LACOMBE and HON. NATHANIEL SHIPMAN, Judges.

THE UNITED STATES ELECTRIC LIGHTING COMPANY,
Appellant,

vs.

THE EDISON ELECTRIC LIGHT COMPANY,
Respondent.

This cause having come on to be heard on appeal from the decree of the Circuit Court of the United States for the Southern District of New York, entered herein July 23d, 1891,

Now, on motion of Eaton & Lewis, solicitors for respondent, it is

Ordered, that said decree be, and the same hereby is, affirmed, with costs of this Court, and that a mandate issue to said Circuit Court, directing said Court to proceed herein according to law.

E. H. L.
N. S.

Digitized by Google

[ENDORSED :]

U. S. Circuit Court of Appeals for the Second Circuit. The United States Electric Lighting Company Appellant, vs. The Edison Electric Light Company, Respondent. Order and Notice of Entry. Due and timely service of a copy of the within Order and Notice of Entry is hereby admitted this 10th day of October, 1892. Kerr & Curtis, Solicitors for Defendant.

[FILE MARK :] United States Circuit Court of Appeals, Second Circuit. Filed Oct. 22d. 1892. John A. Shields, Clerk.

Digitized by Google

Schedule C.

UNITED STATES CIRCUIT COURT,

SOUTHERN DISTRICT OF NEW YORK.

EDISON ELECTRIC LIGHT COMPANY and EDISON GENERAL ELECTRIC COMPANY vs. SAWYER-MAN ELECTRIC COMPANY.	In Equity.

The bill of complaint in this case having been duly filed, and a subpœna duly issued and served upon defendant, and a motion for a preliminary injunction having been brought before this Court for hearing, on the 18th day of November, 1892, upon the bill of complaint, and upon the affidavits of John W. Howell, Francis R. Upton (two affidavits), Thomas A. Edison, George F. Barker, Jacob H. Herrick (two affidavits) and Walter K. Griffin, for the complainants; and the affidavits of Hugh R. Garden, Henry C. Davis, George W. Hebard, George Westinghouse, Jr., Lemuel Bannister, William H. Brown, Frederick Darlington, Edwin F. Baker, Frederick P. Barnes, L. A. Marshall, George W. Sharp, D. A. Tompkins, L. W. Robinson, Jr., William E. Ferra, Calvin B. Humphrey, Joseph C. Hubner, Samuel A. Duncan and Richard S. Browns, for the defendant, and the exhibits and documents therein referred to, and the answer of the defendant;

And C. A. Seward, Grosvenor P. Lowrey and Richard N. Dyer, Esquires, appearing for the complainants, and Edmund Wetmore, Elihu Root and Leonard E. Curtis, Esquires, appearing for the defendant;

And the Court, feeling assured that by granting a *pro forma* order for an injunction *pendente lite*, without trying or hearing the questions involved, an appeal

Digitized by Google

therefrom, promptly taken to the Circuit Court of Appeals for the Second Circuit, will be called and heard as a preferred case at the head of the calendar of that Court for the session beginning December 6, 1892, and no opposition being offered to such course, to facilitate a determination of the questions presented,

It is ordered that an injunction *pendente lite* issue, as prayed for in the bill of complaint herein.

And it is further ordered that upon the issuing of said injunction the operation of the same shall be stayed until the 6th day of December, 1892, or such day thereafter as the Circuit Court of Appeals shall first assemble, and that this stay shall then *ipso facto* terminate, unless the defendant has perfected its appeal (and said case is ready to be called for argument in its due order as a preferred case on the calendar on that date), and defendant then stands ready to argue the same, in which case this stay shall continue until said appeal is decided by the Appellate Court.

ADDISON BROWN.

[ENDORSED:]

United States Circuit Court, Southern District of New York. In Equity. Edison Electric Light Company and Edison General Electric Company vs. Sawyer-Man Electric Company. Order. U. S. Circuit Court. Filed Nov. 19, 1892. John A. Shields, Clerk.

Digitized by Google

Schedule D.

At a Stated Term of the United States Circuit Court of Appeals for the Second Circuit, held in the Court Rooms, in the City of New York, on the 19th day of December, 1892.

Present—

HONORABLE WILLIAM J. WALLACE,
HONORABLE E. HENRY LACOMBE, and
HONORABLE NATHANIEL SHIPMAN,
Judges.

EDISON ELECTRIC LIGHT COMPANY and EDISON GENERAL ELECTRIC COMPANY,
Complainants and Respondents,

vs.

SAWYER-MAN ELECTRIC COMPANY,
Defendant and Appellant.

This cause having come on to be heard on appeal from the order of the Circuit Court of the United States for the Southern District of New York, entered herein November 19th, 1892, granting a preliminary injunction against the defendant, and counsel for the respective parties having been heard by the Court upon the said appeal, it is

Ordered, that the said injunction order appealed from be modified so as to cover only lamps made in infringement of the second claim of the patent in suit, and also by inserting a provision reserving the right to the defendant to move hereafter for the vacation, suspension or modification of the injunction upon proof of specific instances of refusal on the part of the complainants, or either of them, to supply the lamps of the

Digitized by Google

patent upon terms reasonable under the circumstances of the particular case, to the owners of electric lighting apparatus which was installed or purchased before the rendition of the interlocutory decree of the Circuit Court sustaining the validity of the patent for use with such apparatus, and that the order, as so modified, be affirmed.

And it is further ordered that a mandate issue to the said Circuit Court, directing the said Court to modify the said injunction order as above stated, and to proceed herein according to law and justice and to the opinion of this Court.

W. J. W.
E. H. L.
N. S.

O. K.

Dyer & Seely, for Appellees.
Kerr & Curtis, for Appellant.

[Endorsement :]

U. S. CIRCUIT COURT OF APPEALS

For the Second Circuit.

In Equity.

Edison Electric Light Co. and Edison General Electric Company, Complainants and Respondents, vs. Sawyer-Man Electric Company, Defendant and Appellant. Notice and order. Dyer & Seely, Solicitors for Respondent.

[File Mark :] United States Circuit Court of Appeals. Second Circuit. Filed Dec. 21, 1892. John A. Shields, Clerk.

Digitized by Google

Schedule E.

UNITED STATES CIRCUIT COURT,

SOUTHERN DISTRICT OF NEW YORK.

EDISON ELECTRIC LIGHT COMPANY and EDISON GENERAL ELECTRIC COMPANY vs. SAWYER-MAN ELECTRIC COMPANY.	In Equity.

Upon filing the mandate of the United States Circuit Court of Appeals for the Second Circuit in this case, and upon motion of Messrs. Dyer & Seely, solicitors for the complainants, it is

Ordered, that the injunction order heretofore made on the 19th day of November, 1892, be, and the same hereby is, amended so as to read as follows:

Ordered, that the defendant be enjoined *pendente lite* from infringing the second claim of the patent in suit, Letters Patent No. 223,898, granted to Thomas A. Edison, January 27, 1880, with leave to the defendant to move hereafter for the vacation, suspension or modification of the said injunction, upon proof of specific instances of refusal on the part of the complainants, or either of them, to supply the lamps of the patent upon terms reasonable under the circumstances of the particular case, to the owners of electric lighting apparatus which was installed or purchased before the rendition of the interlocutory decree of the Circuit Court sustaining the validity of the patent, for use with such apparatus.

And it is further ordered, that the writ of injunction *pendente lite* heretofore issued and now in force (the

Digitized by Google

same having been so drawn as to cover only the second claim of the patent in suit) continue in force until the further order of this Court.

E. H. Lacombe.

[Endorsed:]

United States Circuit Court, Southern District of New York. Edison Electric Light Company and Edison General Electric Company vs. Sawyer-Man Electric Company. Order amending Injunction Order. Filed Dec. 23, 1892. John A. Shields, Clerk.

Digitized by Google

Schedule F.

UNITED STATES CIRCUIT COURT,

WESTERN DISTRICT OF PENNSYLVANIA.

No. 6, MAY TERM, 1893.

EDISON ELECTRIC LIGHT COMPANY and EDISON GENERAL ELECTRIC COMPANY vs. WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, GEORGE WESTINGHOUSE, JR., and LEMUEL BANNISTER.	In Equity.

And now, to wit, December 27, 1892, this cause came on to be heard on a motion for a preliminary injunction made on part of the Complainants by F. P. Fish and Knox & Reed, counsel for the Complainants, upon the bill of complaint and the affidavits of William F. Yetman, John W. Howell, Francis R. Upton and Jacob H. Harris, and the exhibits referred to in the said bill and affidavits, duly filed on the part of the complainants, and the affidavits of George Westinghouse, Jr., and Lemuel Bannister, duly filed on the part of the defendants, and thereupon, upon consideration thereof,

It is ordered, adjudged and decreed that an injunction from and under the seal of this Court be issued against the defendants, enjoining them, and each of them, their servants, agents and workmen, *pendente lite*, from infringing the second claim of the patent in suit (letters patent No. 223,898 granted to Thomas A. Edison, January 27, 1880), and particularly from making, using or selling any incandescent lamps substantially the same as the exhibits "Complainants'

Digitized by Google

Exhibits Defendants' Lamps Nos. 1, 2 and 3," referred to in complainants' moving papers, and particularly described in the said affidavit of John W. Howell forming a part of the said papers, with leave to the defendants to move hereafter for the vacation, suspension or modification of the injunction upon proof of specific instances of refusal on the part of the complainants, or either of them, to supply the lamps of the patent upon terms reasonable under the circumstances of the particular case to the owners of electric lighting apparatus which was installed or purchased before the rendition of the interlocutory decree of the Circuit Court for the Southern District of New York, namely, July 14, 1891, sustaining the validity of the patent, for use with such apparatus.

BY THE COURT.

[ENDORSED :]

No. 6, May Term, 1893. U. S. Circuit Court, Western District of Penna. Edison Electric Light Co. and Edison General Electric Co. vs. Westinghouse Electric and Manufacturing Company *et al.* Copy. Order Granting Preliminary Injunction. Filed Decr. 27, 1892. H. D. Gamble, Clerk.

Digitized by Google

Schedule G.

UNITED STATES CIRCUIT COURT,

DISTRICT OF CONNECTICUT.

EDISON ELECTRIC LIGHT COMPANY ET AL. vs. THE PERKINS ELECTRIC LAMP COMPANY ET AL.	In Equity.

Upon the bill of complaint as filed herein, and upon the affidavits of Charles Deshler, Charles L. Clarke, Henry K. Marvell, Francis R. Upton, Jacob H. Herrick and Frank Wheaton, and the patents, papers and documents therein referred to, and upon the record on appeal from an order granting a preliminary injunction in the case of Edison Electric Light Company and Edison General Electric Company vs. Sawyer-Man Electric Company, in the United States Circuit Court of Appeals for the Second Circuit, and upon the record made for final hearing in the case of The Edison Electric Light Company vs. The United States Electric Lighting Company (In Equity, No. 3445), pending in the United States Circuit Court for the Southern District of New York, said two records having been temporarily deposited in the office of the Clerk of this Court for the purposes of this order, and upon the service upon the defendants of the subpœna herein, and of copies of said bill and affidavits, let the defendants show cause before me at a term of this Court to be held at the Court Rooms thereof, in the City of Hartford, on Friday, the 6th day of January, 1893, at 2.30 o'clock in the afternoon, or as soon thereafter as counsel can be heard, why a preliminary or provisional injunction should not issue herein, according to the prayer of the bill in that behalf, and

Digitized by Google

why the complainants should not have such other or further or different relief as to the Court then and there may seem meet; and in the meantime, and until the return day of this order, and the decision of the Court thereon, the said defendants and each of them, and the attorneys, solicitors, servants, agents and workmen of them, and each of them, are, sufficient statutory cause existing therefor, restrained from distributing in any manner any incandescent electric lamps made in accordance with or embodying or containing any of the inventions or improvements described in said letters patent, and recited in the second claim thereof, and especially from distributing any incandescent electric lamps substantially the same as the "Complainants' Exhibits Defendants' Lamps, Nos. 1, 2, 3 and 4," referred to in complainants' moving papers, and particularly described in the affidavit of Henry K. Marvell, forming a part of the said papers.

Dated December 31, 1892.

N. SHIPMAN,
Circuit Judge.

[ENDORSED:]

No. 737. U. S. Circuit Court, Dist. of Connecticut. Edison Electric Light Company *et al.* vs. Perkins Electric Lamp Company *et al.* Order to Show Cause. Filed Dec. 31, 1892. E. E. Marvin, Clerk.

Digitized by Google

Schedule H.

UNITED STATES CIRCUIT COURT,

DISTRICT OF CONNECTICUT.

EDISON ELECTRIC LIGHT COMPANY ET AL. vs. THE MATHER ELECTRIC COMPANY ET ALS.	In Equity.

Upon the bill of complaint as filed herein, and upon the affidavits of Charles Deshler, Charles L. Clarke, Henry K. Marvell, Francis R. Upton, Jacob H. Herrick and Frank Wheaton, and the patents, papers and documents therein referred to, and upon the record on appeal from an order granting a preliminary injunction in the case of Edison Electric Light Company and Edison General Electric Company vs. Sawyer-Man Electric Company, in the United States Circuit Court of Appeals for the Second Circuit, and upon the record made for final hearing in the case of The Edison Electric Light Company vs. The United States Electric Lighting Company (In Equity, No. 3445), pending in the United States Circuit Court for the Southern District of New York, said two records having been temporarily deposited in the office of the Clerk of this Court for the purposes of this order, and upon the service upon the defendants of the subpœna herein. and of copies of said bill and affidavits, let the defendants show cause before me at a term of this Court to be held at the Court Rooms thereof, in the City of Hartford, on Friday, the 6th day of January, 1893, at 2:30 o'clock in the forenoon, or as soon thereafter as counsel can be heard, why a preliminary or provisional injunction should not issue herein, according to the prayer of the bill

Digitized by Google

in that behalf, and why the complainants should not have such other or further or different relief as to the Court then and there may seem meet; and in the meantime, and until the return day of this order, and the decision of the Court thereon, the said defendants, and each of them, and the attorneys, solicitors, servants, agents and workmen of them, and each of them, are, sufficient statutory cause existing therefor, restrained from distributing in any manner any incandescent electric lamps made in accordance with or embodying or containing any of the inventions or improvements described in said letters patent and recited in the second claim thereof, and especially from distributing any incandescent electric lamps substantially the same as the "Complainants' Exhibits Defendants' Lamps, Nos. 1, 2, 3 and 4," referred to in complainants' moving papers, and particularly described in the affidavit of Henry K. Marvell, forming a part of the said papers.

Dated December 31, 1892.

N. Shipman,
Circuit Judge.

[Endorsed :]

No. 736. U. S. Circuit Court, Dist. of Connecticut. Edison Electric Light Company *et al.* vs. Mather Electric Company *et al.* Order to Show Cause. Filed Dec. 31, 1892. E. E. Marvin, Clerk.

Digitized by Google

Schedule I.

CIRCUIT COURT OF THE UNITED STATES,

DISTRICT OF CONNECTICUT.

EDISON ELECTRIC LIGHT CO. ET AL.
vs.
THE PERKINS ELECTRIC LAMP CO. ET AL.
} In Equity.

On the bill of complaint in the above-entitled cause, and the affidavits filed by the complainants therein, and upon hearing counsel for the complainants and defendants therein, it is ordered,

That the defendants, and each and every of them, and their and each of their clerks, attorneys, servants, agents, officers and workmen, be, and are hereby, enjoined and restrained, until the final hearing of this cause and the further order of this Court, from making, using or vending any incandescent electric lamps embodying or containing any of the inventions shown or described in letters patent of the United States No. 223,898 to Thomas A. Edison, and claimed in the second claim thereof, and from shipping and distributing to others such lamps, and, in particular, from making, using, vending, shipping or distributing to others any lamps substantially the same in construction and mode of operation as the "Complainant's Exhibits Defendant's Lamps" Nos. 1, 2, 3 and 4, referred

Digitized by Google

to in complainant's moving papers, and particularly described in the affidavit of Henry K. Marvell, forming a part of said papers.

January 6th, 1893.

N. SHIPMAN,
Circuit Judge.

[ENDORSED :]

No. 737 U. S. Circuit Court District of Conn. Edison Electric Light Co. *et. al.* vs. Perkins Electric Light Co. *et. al.* Decree for Injunction. Filed January 6th. 1893. E. E. Marvin. Clerk Copy.

Digitized by Google

Schedule J.

UNITED STATES CIRCUIT COURT,

DISTRICT OF CONNECTICUT.

EDISON ELECTRIC LIGHT CO. ET AL. vs. THE MATHER ELECTRIC CO. ET. AL.	In Equity.

On the bill of complaint in the above-entitled cause and the affidavits filed by the complainants therein, and upon hearing counsel for the complainants and defendants therein,

It is ordered, that the defendants, and each and every of them, and their and each of their clerks, attorneys, servants, agents, officers and workmen, be, and are hereby, enjoined and restrained until the final hearing of this cause and the further order of this Court from making, using or vending any incandescent electric lamps embodying or containing any of the inventions shown or described in Letters Patent of the United States No. 223,898 to Thomas A. Edison, and claimed in the second claim thereof, and from shipping and distributing to others such lamps, and, in particular, from making, using, shipping or distributing to others any lamps substantially the same in construction and mode of operation as the "Complainants' Exhibits Defendants' Lamps Nos. 1, 2, 3 and 4," referred to in complainant's moving papers, and particularly described in the affidavit of Henry K. Marvell, forming part of said papers; with leave to the defendants to move hereafter for the vacation, suspension or modification of the injunction upon proof of specific instances of refusal on the part

Digitized by Google

of the complainants, or either of them, to supply the lamps of the patent upon terms reasonable under the circumstances of the particular case, to the owners of electric lighting apparatus made by the Mather Electric Company which was installed or purchased before the rendition of the interlocutory decree of the Circuit Court for the Southern District of New York, namely, July 14, 1891, sustaining the validity of the patent, for use with such apparatus.

Dated January 6, 1893.

N. SHIPMAN,
Circuit Judge.

[ENDORSED :]

No. 736. U. S. Circuit Court, District of Conn. Edison Electric Light Company, *et al.* vs. The Mather Electric Lamp Co. *et al.* Decree for Injunction. Filed Jan. 6th, 1893. E. E. Marvin, Clerk.

Digitized by Google

Schedule K.

UNITED STATES CIRCUIT COURT,

NORTHERN DISTRICT OF ILLINOIS, NORTHERN DIVISION.

SATURDAY, January 14, 1893.

Present—HON. PETER S. GROSSCUP, District Judge.

EDISON ELECTRIC LIGHT COMPANY ET AL. vs. ILLINOIS ELECTRIC LAMP COMPANY ET AL.	In Chancery.

On the bill and affidavits in the above-entitled cause filed on behalf of the complainants, and on motion of the complainants, it is ordered, that the defendants show cause at the Court Rooms of this Court in Chicago, Illinois, on Saturday the 21st day of January, 1893, at 10 o'clock in the forenoon, why an injunction *pendente lite* should not issue against them according to the prayer of the bill, and that until the hearing and decision of the motion for such injunction on which the foregoing order is made, and until the further order of this Court, the defendants, and each and every of them, and their and each of their clerks, attorneys, workmen, agents and servants, be, and they hereby are, enjoined and restrained from shipping, distributing or delivering to others any incandescent lamps constructed according to or embodying any of the inventions shown and described in letters patent to Thomas A. Edison, No. 223,898, in said bill named, and claimed in the second claim thereof, and, in particular, from shipping, distributing or delivering to others any incandescent lamps like, in construction and mode of operation, the incandescent lamps referred to in complainants' moving affidavits as having been heretofore made and sold by the defendants.

Digitized by Google

Schedule L.

UNITED STATES CIRCUIT COURT,

NORTHERN DISTRICT OF ILLINOIS, NORTHERN DIVISION.

SATURDAY, January 14, 1893.

Present—HON. PETER S. GROSSCUP, District Judge.

EDISON ELECTRIC LIGHT COMPANY ET AL vs. SUNBEAM INCANDESCENT LAMP COMPANY ET AL.	In Chancery.

On the bill and affidavits in the above-entitled cause, filed on behalf of the complainants, and on motion of the complainants, it is ordered that the defendants show cause at the Court Rooms of this Court in Chicago, Illinois, on the 21st day of January, 1893, at 10 o'clock in the forenoon, why an injunction *pendente lite* should not issue against them according to the prayer of the bill, and that until the hearing and decision of the motion for such injunction on which the foregoing order is made, and until the further order of this Court, the defendants, and each and every of them, and their and each of their clerks, attorneys, workmen, agents and servants, be, and they are hereby, enjoined and restrained from shipping, distributing or delivering to others any incandescent lamps constructed according to or embodying any of the inventions shown and described in letters patent to Thomas A. Edison, Number 223,898, in said bill named, and claimed in the second claim thereof, and in particular from shipping, distributing or delivering to others any incandescent lamps like, in construction and mode of operation, the incandescent lamps referred to in complainants' moving affidavits as having been heretofore made and sold by the defendants.

Digitized by Google

Schedule M.

UNITED STATES OF AMERICA,
Eastern Division of the Eastern
Judicial District of Missouri, } ss.:

IN THE CIRCUIT COURT OF THE UNITED STATES, IN AND FOR THE EASTERN DIVISION OF SAID DISTRICT.

Be it Remembered, That on the seventeenth day of January, A. D. 1893, the following, among other proceedings, were had and appear of record in said Court, to-wit:

(Restraining Order and Order to Show Cause.)

Edison Electric Light Company *et al.*, Complainants,
3707 vs.
Columbia Incandescent Lamp Co. *et al.*, Defendants.

On the bill of complaint in the above-entitled cause and the affidavits filed by complainants in support of their motion for a preliminary injunction therein, it is

Ordered, That the defendants show cause at the Court rooms of this Court, in St. Louis, Missouri, on Wednesday, the first day of February, 1893, at ten o'clock in the forenoon, why a preliminary injunction should not issue against them, according to the prayer of said bill, and that, until the hearing and decision of the motion for a preliminary injunction, with reference to which the foregoing order is made, and until the further order of this Court, the defendants, and each and every of them, and their and each of their clerks, attorneys, servants, agents and workmen be, and they hereby are, enjoined and restrained from shipping or distributing to others any incandescent lamps constructed according to or embodying the inventions shown and described in letters patent of the United States to Thomas A. Edison No. 223,898, in said bill

Digitized by Google

named, and claimed in the second claim of said letters patent, and, in particular, from so shipping or distributing any incandescent lamps like, in construction and mode of operation, to the incandescent lamps referred to in complainants' moving affidavits as having heretofore been made and sold by said defendants.

And it is further ordered that within five days from this date complainants cause a copy of their bill and moving papers to be served upon the defendants.

(Signed) A. M. THAYER,
Judge.

Dated January 17, 1893.

Digitized by Google

Schedule N.

CIRCUIT COURT OF THE UNITED STATES,

DISTRICT OF MASSACHUSETTS.

IN EQUITY.

EDISON ELECTRIC LIGHT COMPANY ET AL. v. BEACON VACUUM PUMP AND ELECTRICAL COMPANY ET AL.	No. 3096.

ORDER OF COURT.

(FEBRUARY 18, 1893.)

COLT, J.:

This cause came on to be heard upon motion of complainants for a preliminary injunction, and was argued by counsel for the respective parties, and now, to wit: February 18, 1893, it is ordered by the Court that a writ of injunction issue, as prayed for in the bill of complaint herein, enjoining and restraining said defendants, and each of them, and the at orneys, solicitors, servants, agents and workmen of them, and each of them, from directly or indirectly making or causing to be made, or using or causing to be used, or vending to others to be used, or distributing in any manner, any incandescent electric lamps made in accordance with or embodying or containing any of the inventions or improvements shown or described in Letters Patent of the United States No. 223,898, to Thomas A. Edison, and claimed in the second claim thereof, and from vending or distributing any such incandescent electric lamps, and from infringing upon or violating the said letters patent in any way, and in particular from making, using, vending, shipping or distributing to others any

Digitized by Google

lamps substantially the same in construction and mode of operation as the Complainants' Exhibits "Beacon Lamp No. 1" and "Beacon Lamp No 2," referred to in complainants' moving papers, and particularly described in the affidavit of John W. Howell, forming a part of said papers, until the further order of the Court.

By the Court,
Benj. H. Bradlee,
Deputy Clerk.

Digitized by Google

Schedule O.

CIRCUIT COURT OF THE UNITED STATES,

DISTRICT OF MASSACHUSETTS.

OCTOBER TERM, 1892.

IN EQUITY.

THE EDISON ELECTRIC LIGHT COMPANY ET AL., Complainants, vs. THE BOSTON INCANDESCENT LAMP COMPANY ET AL., Defendants.	No. 3123.

FINAL DECREE.

(MARCH 17, 1893.)

COLT, J.: This cause came on to be heard at the October Term (1892) of this Court upon the bill and the stipulation of the parties; upon consideration thereof, to wit: March 16, 1893. It is ordered, adjudged and decreed as follows, viz., that the letters patent referred to in the complainants' bill being Letters Patent of the United States, granted unto Thomas A. Edison, No. 223,898, dated January 27, 1880, is a good and valid patent; and that the said Thomas A. Edison was the original and first inventor of the improvement described and claimed therein; and that the said defendants have infringed the second claim of said patent, and upon the exclusive rights of the complainants under the same.

And it is further ordered, adjudged and decreed that

Digitized by Google

the complainants recover of the defendants the profits which they have received or made, or which have accrued to them from said infringement by the manufacture, use or sale of the improvement described and secured by the second claim of said letters patent, at any and all times since the twenty-seventh day of January, 1880, and, in addition thereto, the damage which the complainants have sustained thereby.

And it being agreed by the parties that reference to a Master be waived, and the profits and damages to be recovered by the complainants of the defendants in said cause be assessed at the sum of one dollar, it is further ordered, adjudged and decreed that the complainants recover of the defendants the sum of one dollar as damages and profits for said infringement, and that execution issue therefor.

And it is further ordered, adjudged and decreed that a perpetual injunction be issued against the defendants, according to the prayer of the bill.

And it is further ordered, adjudged and decreed that the complainants recover of the defendants their costs of suit.

By the Court,

Benj. H. Bradlee,

Deputy Clerk.

Digitized by Google

Schedule P.

CIRCUIT COURT OF THE UNITED STATES,

District of Massachusetts.

October Term, 1892.

In Equity.

The Edison Electric Light Company et al., Complainants, vs. The Germania Electric Company et al., Defendants.	No. 3124.

FINAL DECREE.

(March 17, 1893.)

Colt, J.:

This case came on to be heard at the October Term (1892) of this Court upon the bill and the stipulation of the parties; upon consideration thereof, to wit, March 16, 1893, it is ordered, adjudged and decreed, as follows, viz., that the letters patent referred to in the complainants' bill, being Letters Patent of the United States, granted unto Thomas A. Edison, No. 223,898, dated January 27, 1880, is a good and valid patent; and that the said Thomas A. Edison was the original and first inventor of the improvement described and claimed therein; and that the said defendants have infringed the second claim of said patent, and upon the exclusive rights of the complainants under the same.

Digitized by Google

And it is further ordered, adjudged and decreed, that the complainants recover of the defendants the profits which they have received or made, or which have accrued to them, from said infringement by the manufacture, use or sale of the improvement described and secured by the second claim of said Letters Patent, at any and all times since the 27th day of January, 1880, and, in addition thereto, the damage which the complainants have sustained thereby.

And it being agreed by the parties that reference to a Master be waived, and the profits and damages to be recovered by the complainants of the defendants in said cause be assessed at the sum of one dollar, it is further ordered, adjudged and decreed, that the complainants recover of the defendants the sum of one dollar as damages and profits for said infringement, and that execution issue therefor.

And it is further ordered, adjudged and decreed, that a perpetual injunction be issued against the defendants according to the prayer of the bill.

And it is further ordered, adjudged and decreed, that the complainants recover of the defendants their costs of suit.

By the Court,

Benj. H. Bradlee,

Deputy Clerk.

Digitized by Google

Schedule Q.

UNITED STATES CIRCUIT COURT,

DISTRICT OF CONNECTICUT.

EDISON ELECTRIC LIGHT CO. ET AL. vs. THE CONNECTICUT GLASS CO. ET AL.	In Equity.

On the bill and affidavits in the above-entitled cause, filed on behalf of the complainants, and on motion of complainants :

It is ordered, that the defendants show cause at the Court Rooms of this Court in Hartford, Connecticut, on Saturday, the 25th day of March, 1893, at 12 o'clock noon, why a preliminary or provisional injunction should not issue herein, according to the prayer of the bill in that behalf, and in the meantime and until the return day of this order, and the decision of the Court thereon, the said defendants and each of them, and the attorneys, solicitors, servants, agents and workmen of them, and each of them, be, and they are hereby, enjoined and restrained from making, using, vending, shipping, distributing or delivering to others any incandescent electric lamps constructed according to or embodying any of the inventions shown and described in letters patent to Thomas A. Edison, Number 223,-898, in said bill named, and claimed in the second claim thereof, and in particular from making, using, vending, shipping, distributing or delivering to others any incandescent electric lamps like, in construction and mode of operation, the incandescent electric lamps referred to in complainants' moving papers as having been heretofore sold by the defendants.

Dated March 20th, 1893.

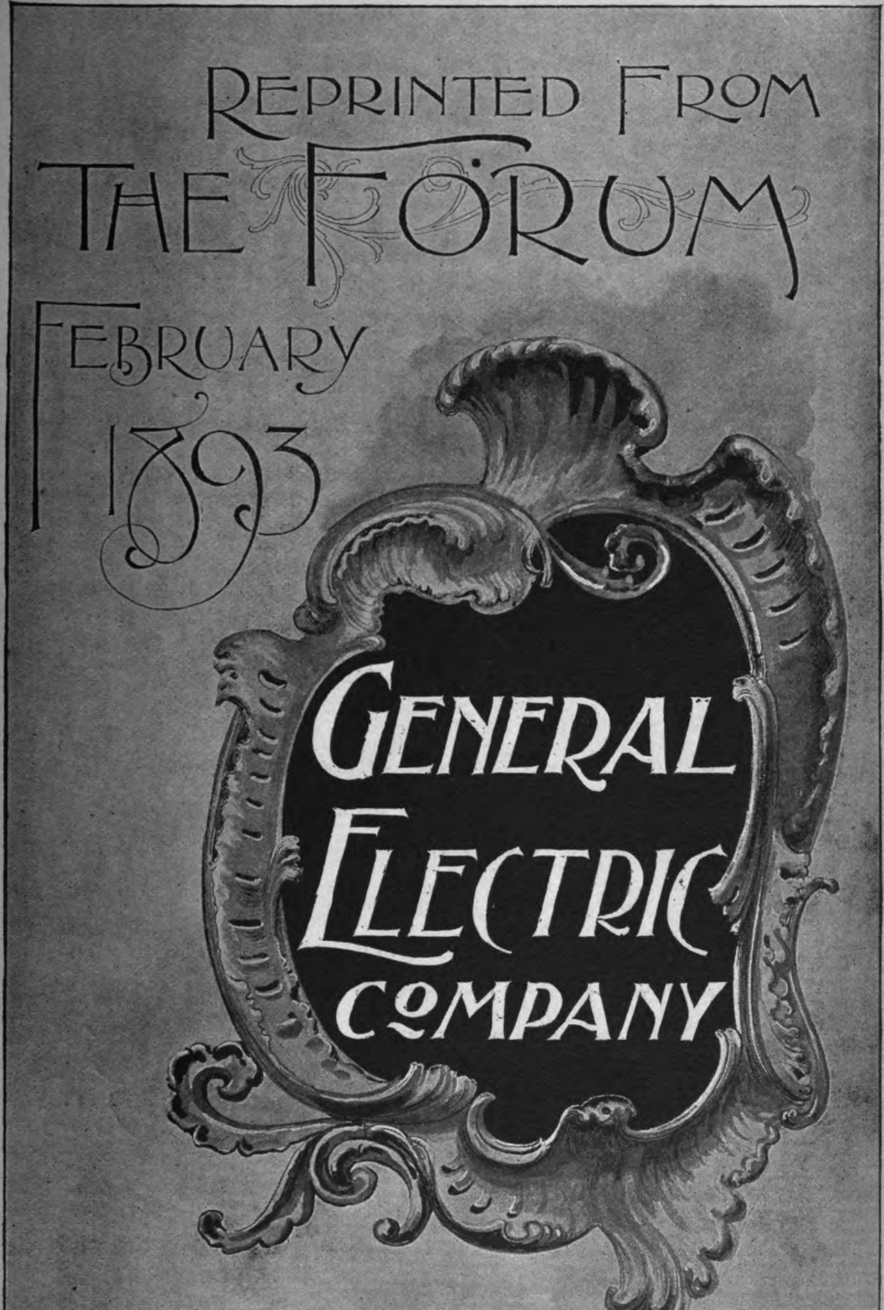
N. SHIPMAN, Circuit Judge.

Digitized by Google

Digitized by Google

Digitized by Google

APPENDIX I.



Digitized by Google

TRIUMPHANT INDUSTRIES.

THE GENERAL ELECTRIC COMPANY

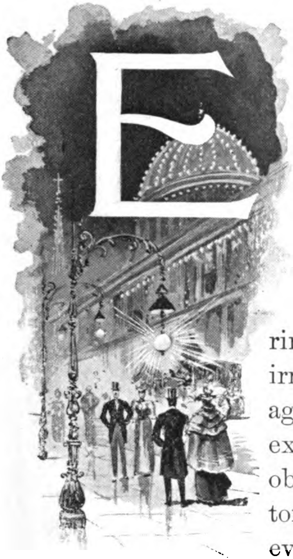
DURING this Columbian year there will be published in the Publishers' Department of THE FORUM descriptions of such "Triumphant Industries" as mark the progress of American invention and development; and here some of the greatest inventors and manufacturers in the world—builders of the great industrial triumphs that we celebrate—will address one of the best groups of readers in the world; for perhaps nowhere else are there written together the names of people of greater influence or of greater wealth than on the subscription-books of THE FORUM.

The descriptions that are admitted here are only of those great industries about which interesting articles may be written—articles that set forth plainly great facts about great achievements; and they are published with the commendation of

THE FORUM PUBLISHING COMPANY.

Digitized by Google

GENERAL ELECTRIC COMPANY.



EMERSON once said that steam was half an Englishman. With equal felicity and more truth it might be affirmed that electricity is half an American. That which our philosophic countryman noted as a characteristic phenomenon was the creation of a modern England with immense factories, great lines of railroad, and a ubiquitous mercantile marine, operated by an agency all-predominating and irresistible. Such it remains to this day. But no agency that seconds human effort need be so exclusively adopted as to prove at last seriously obstructive of further advances. One good custom soon corrupts the world, and progress must ever find new ways and new tools. In America, with all the resources of a virgin soil to open up; with greater distances to overcome; with a larger population more widely distributed to be kept in closer touch; with a keener appreciation of economies in time than of those in mere coin; with a pervading belief that novelty is apt to have merit simply because it is new, the nation has been swift to approve and to adopt each discovery in the electric arts.

A distinguished English physicist is credited with the remark that he did not care to do anything by electricity when he could do it some other way. Even Bismarck, though willing to be night telegraph editor, grumbled sourly at the instantaneous effectiveness of the wire and key as spoiling all the stately traditions of diplomacy. But the average American citizen is of quite different temper and spirit, always preferring the prompt, direct electric method for aught that concerns him and his kind.

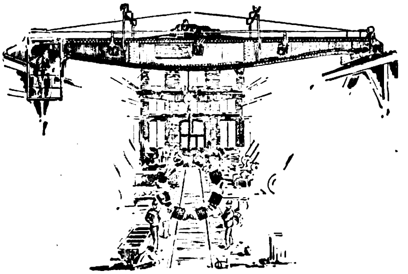
It is thus that the humble beginnings of Morse have fructified in a continental network of telegraphs. It is thus that the Atlantic cable—the one idea of a plain New York business man—came into successful operation. It is thus that the inchoate, frontier city, still

Digitized by Google

smelling of raw lumber and fresh paint, has more telephones than many a proud and dignified Old World capital. It is thus that America has become the great centre of production and use of electric light and power, and exports her lamps, her dynamos, her motors, and her electric cars to every quarter of the globe.

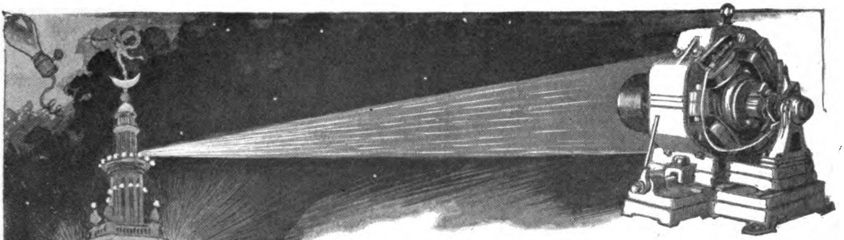
Glimpse of Lamp Factory.

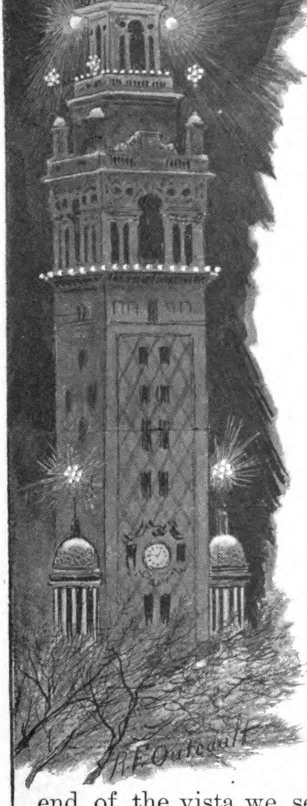
Naturally enough, giant industries identified with the various branches of electrical application have sprung into being in swift succession: the Western Union Telegraph Company, gathering up into a vast system the telegraph lines of the country; the American Bell Telephone Company, controlling the apparatus by which five hundred million conversations are carried on over the wires every year; and now, in the orderly progression of events, third and most comprehensive, the General Electric Company, based on the patented inventions of such men as Thomas A. Edison, Elihu Thomson, Brush, Sprague, Van Depoele, and a host of others, by means of whose valuable ideas and its enormous financial and manufacturing resources it holds a like parental relation toward all the later marvellous developments in electric light, heat, traction, and power.


Electric Travelling Crane.

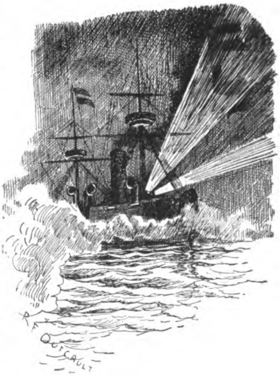
THE backward glance over a few years shows how young all this work is that the General Electric Company is engaged in, and yet with what extraordinary celerity the dreams and yearnings of the pioneers have been transmuted and crystallized into stocks and bonds stowed away in safe-deposit vaults; into throbbing factories and armies of artisans; into millions of brilliant lights; into thousands of electric cars; into hundreds of magnificent central stations. The true romance of history lies in such growth. At one end of the short vista is Edison, an eager stripling isolated at bleak Menlo Park, making three thousand laborious experiments to perfect his incandes-

Digitized by Google



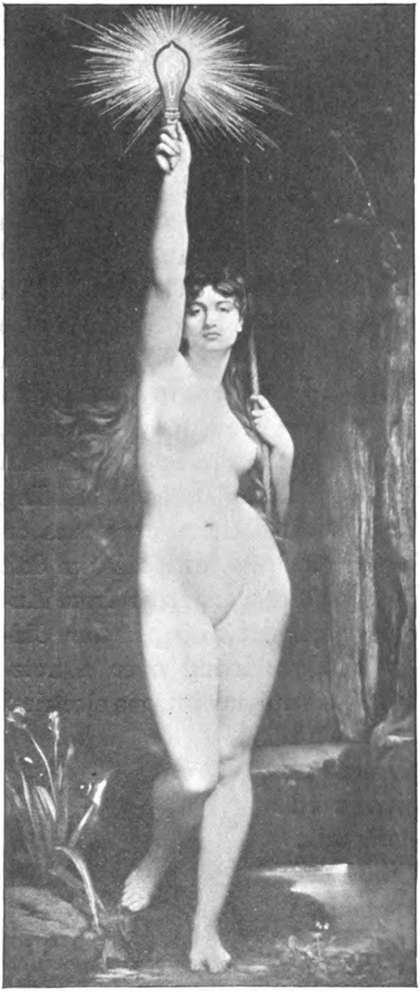


cent lamp, the sole invention of which has now been adjudged his by the United States Supreme Court. At one end of the vista we see, too, in those grim early days of struggle, Van Depoele carving saints and altar screens all day long in his little Western wood-working atelier, and then puzzling all the long night over lamp and motor models. We see Elihu Thomson, a modest, ill-paid young professor of physics at the Philadelphia High School, building all manner of novel electrical apparatus, on revolutionary principles, with his own deft hands. We see Sprague, fresh from Annapolis, a poor ensign, cruising in dim Chinese waters, and pondering over a note-book that he fills with mysterious electrical diagrams, but with never a nautical yarn nor a word of traveller's talk. And at the near end of the vista we see the accomplished facts, the fine Edison Building on Broad Street, and its occupant, the General Electric Company. We see a corporation whose capital of fifty million dollars represents the aggregation of successive investments at each evolutional stage of the art. We see allied with it over two thousand American local



Naval Search-Light.

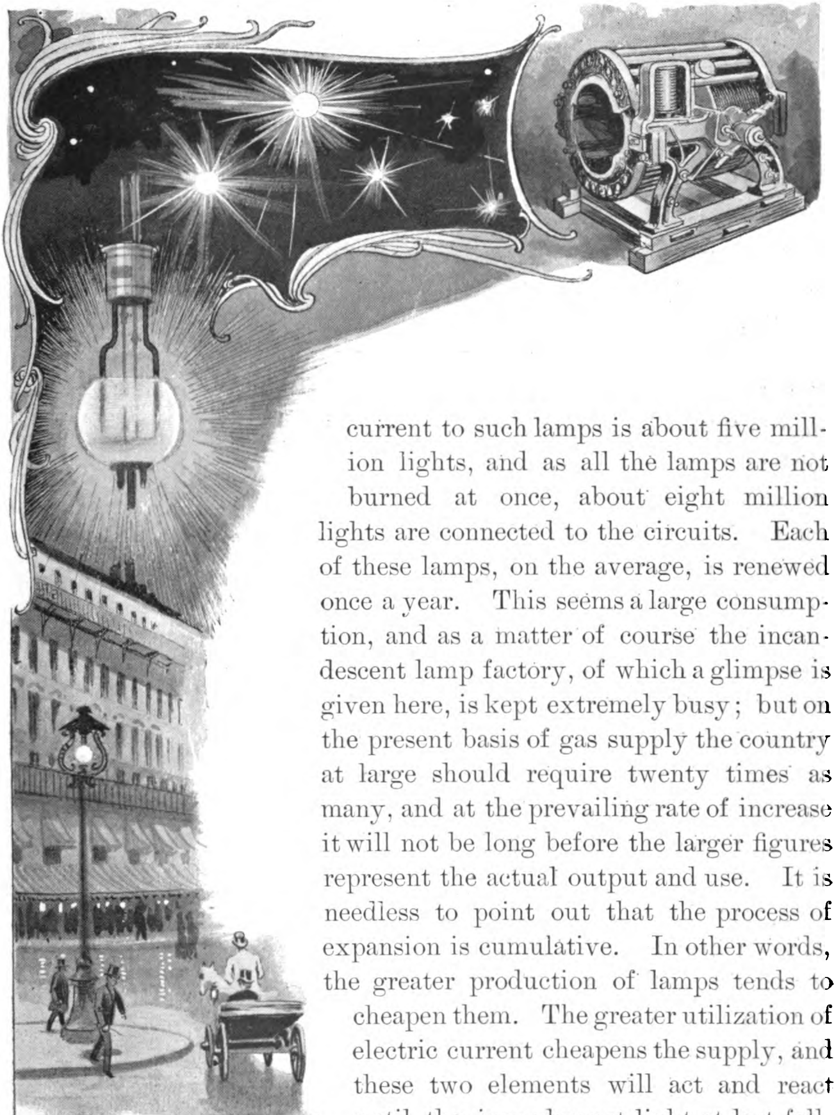
electric-lighting and electric-railway companies, the direct consumers of its multitudinous manufactures, and in turn themselves the immediate servitors of the entire urban population of the United States.


PER ASPERA AD LUCEM.

There is not a railroad in the country that has so many ramifications as this "industrial," not one that has such an area to draw revenue from in return for what it supplies. The permanence and stability of an enterprise is often judged by the variety of its product and the extent of its markets, insuring steadiness of demand and of profit despite local fluctuations and incidental dulness. The application of such a test reveals at once the difficulty of setting any bounds to the consumption of apparatus and supplies in a limitless field developed but yesterday and where every forecast of possible demand falls short of the mark. Already the General Electric Company does a business reaching many millions of dollars per annum.

Look at the introduction of the incandescent lamp, for example. The lamp-works (Harrison, N. J.) of the General Electric Company produce about thirty-five thousand or forty thousand a day, under the Edison patent, which is absolutely controlling so far as concerns the only form of lamp that is known to the art as practicable. The capacity of the dynamos installed in this country to furnish

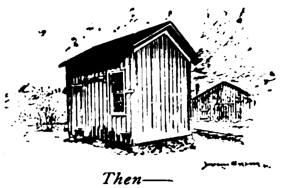
Digitized by Google



current to such lamps is about five million lights, and as all the lamps are not burned at once, about eight million lights are connected to the circuits. Each of these lamps, on the average, is renewed once a year. This seems a large consumption, and as a matter of course the incandescent lamp factory, of which a glimpse is given here, is kept extremely busy; but on the present basis of gas supply the country at large should require twenty times as many, and at the prevailing rate of increase it will not be long before the larger figures represent the actual output and use. It is needless to point out that the process of expansion is cumulative. In other words, the greater production of lamps tends to cheapen them. The greater utilization of electric current cheapens the supply, and these two elements will act and react until the incandescent light at last falls within the reach of even those who could not afford gas. The demonstration of this is seen in the one sketch of Edison's little pioneer station at Appleton, Wis., and the other illustrating one of the more recent central stations in New York City. It is

Digitized by Google

to be found also in the engraving of the large multipolar direct-connected generator, in which engine and dynamo, both of colossal proportions, are so intimately associated that current is generated in



Then—

immense quantities at a minimum waste and with a maximum efficiency. These "units" in the modern central station are democratizing the electric light at a rapid rate, and they are also placing electric power at the disposal of the smallest consumer far cheaper than he can run his own engine with steam, gas, or oil.

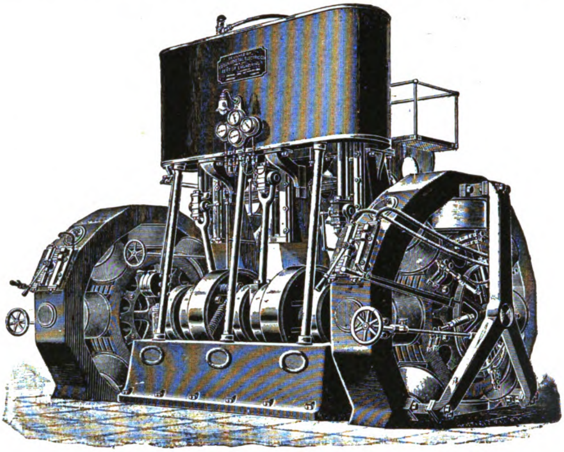
The advantages of incandescent lighting need hardly be expatiated upon to-day. So far as can be ascertained, there is no large new building in course of construction in the United States that is without provision for electricity as an illuminant. Yet the matter is entirely one of free choice. Gas was never better or cheaper than it now is, but electricity receives the preference. If, then, it be not compulsion, it must be conviction. The public are satisfied that electricity is best, and want it, sometimes on hygienic grounds, sometimes to save books and paintings, sometimes to protect the pristine beauty of upholsterings and tapestries, sometimes for the mere sake of greater brightness—often for all these reasons combined. Hence we see every year increased freedom in the use of delicate tints and textures for domestic interiors, as well as novel schemes of decoration, with light as the chief auxiliary to accentuate and enrich.

and Now.

This in-door electric lighting is a boundless territory, but out-door

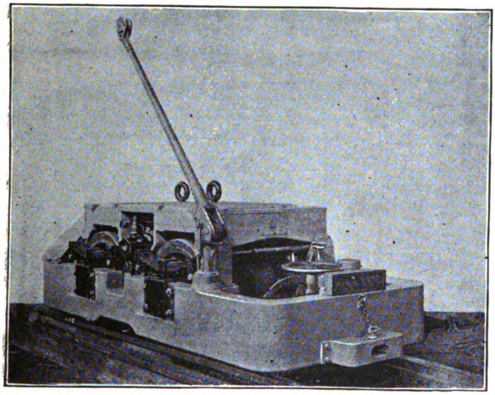
Digitized by Google

arc lighting is also a pretty big West to grow up with. Half a million arc lights, made and sold under the patents of the General Electric Company, gleam along the streets of nearly every city in the Union, and they are fast crowding out gas, so that in a great many municipalities only they are to be seen. Their use does not end here, however, for they are flashed along the shores of all our rivers by hundreds of steamboats feeling the way with a finger of light, while every new man-of-war wants a more powerful "search" than its predecessor can boast of. It is even to be feared that in the near future arc-lighting apparatus will be in brisk demand for celestial sign-painting and advertising on the clouds, when the battles of rival bill-posters will be fought out in the heavens instead of on the fences.



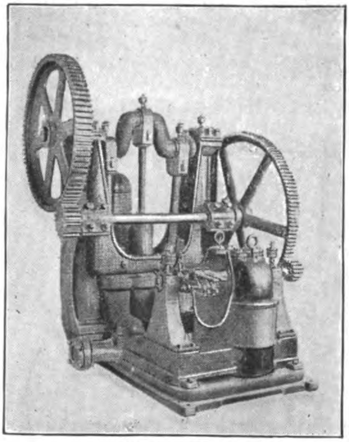
Modern Multipolar Generator.

More ornamental, certainly, is the use of the electric arc light in brilliant festoons as it may be seen outside theatres and other places of popular resort. More ornamental, decidedly, is the clever advertising done with banks of incandescent lamps, furnished with current from the ordinary street-mains and catching the eye at some frequented street-corner. Madison Square, New York, this year, has been a brilliant example of all the latest "wrinkles" in these fields. The



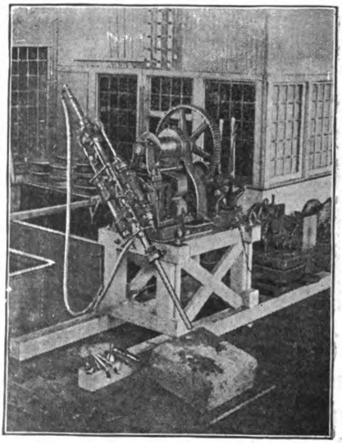
Electric Mining Locomotive.

Digitized by Google



Electric Pump.

Garden tower, outlined by incandescents and crowned by an insistent search-light, has lifted its glittering bulk high above the trees of the park and the city roar. Not far away, against a lofty blank wall, full fifteen hundred colored lamps, flashing in and out, have invited attention to the grateful sea-breezes that sweep across Coney Island and to the pleasant homes that a man can find on the Long Island Railroad. Summer has gone and the soft breezes with it; but on the opposite side of the square, in letters of fire that stand out sharply in the winter night, these lamps now proclaim the fact that a new brand of cigarettes has captured the town. This availability of the incandescent light for spectacular purposes is becoming greatly appreciated. The recent Columbus celebrations gave evidence of this fact in New York and Chicago, while in St. Louis a magnificent series of historical and emblematic arches were shown with the help of hundreds of incandescent lamps structurally arranged. Of other smaller work of the same character the Actors' Fund Fair in New York and the Grand Army Encampment in Washington presented conspicuously successful examples. And yet it may be doubted whether any idea in this line was more original than that carried out recently at Wilmington, N. C., where a number of floats in a gorgeous night street parade were fitted up with ornamental designs in incandescent lamps and took current for them along the whole route from the overhead wires of the trolley car service.



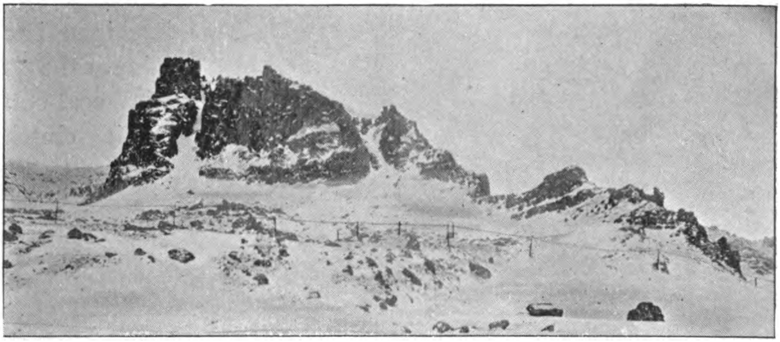
Electric Drill.

At one time it was supposed that incandescent lighting could only be done on circuits adjacent to the central station, and that beyond such a limited area only the arc light was available.

Digitized by Google

To enlarge the district supplied Edison invented his famous three-wire system, but an even wider territory can be embraced by the alternating systems of Thomson, Slattery, and others. To-day there are any number of incandescent lamps burning brightly and steadily five miles away from the central station, thanks to the apparatus thus furnished; and what has been done in lighting in this way is being repeated in power transmission. In 1891, with alternating-current apparatus, electric power was transmitted more than one hundred miles in Germany. It was a tour de force, but in America the power of the falls of Niagara is about to be transported to Buffalo in a similar manner. The work already nears completion.

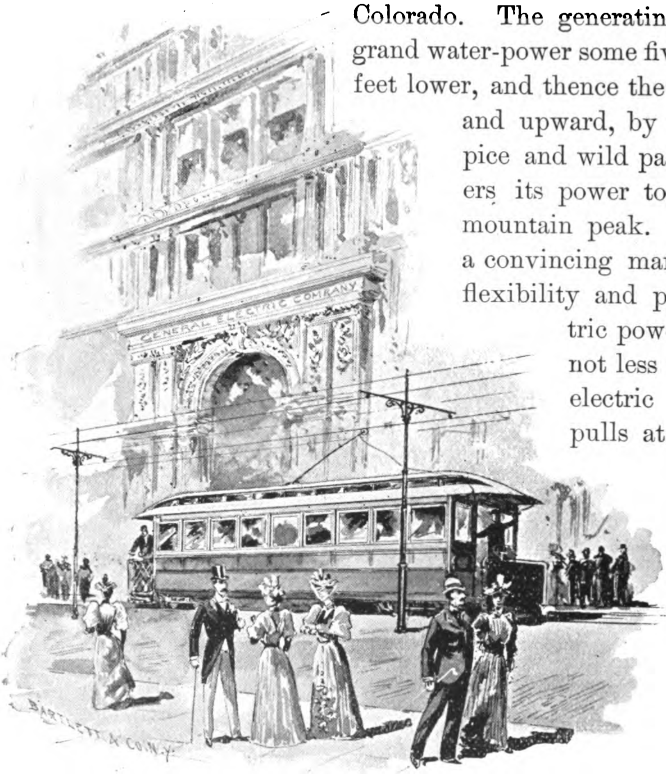
This problem of power transmission is of the most vital interest to the mining industry, and by means of either direct or alternating



Electric Power above the Snow-Line.

current apparatus, the General Electric Company has been instrumental in placing not a few mines on the paying basis. In fact, great as is the field of electric traction, it is asserted by experts that the field of electric mining is even more extensive. Be this as it may, electricity is being used for hauling, pumping, ventilating, excavating, crushing, drilling, and hoisting in coal, iron, silver, copper, and gold mines all over this country. A peculiarity of this department of work is that it has rendered useful and highly valuable water-powers hitherto running idle, while the mines near by were consuming very costly fuel or else lay unworked because of the comparatively low grade of the ore. The striking illustration on this page is taken from a photograph of an electric power line crossing a snowy plateau twelve thousand feet above the sea-level and serving the Virginius Mines in

Digitized by Google



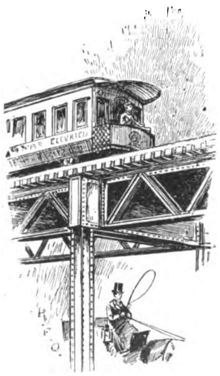
Modern Rapid Transit.

Colorado. The generating plant utilizes a grand water-power some five or six thousand feet lower, and thence the line runs upward and upward, by chasm and precipice and wild passes, till it delivers its power to the mine at the mountain peak. This is, indeed, a convincing manifestation of the flexibility and portability of electric power in mining, but not less illustrative is the electric locomotive as it pulls at the long line of trucks in a Michigan iron mine or the electric coal-cutter as it clutches the heart out of a thick seam in an Illinois coal pit.

Of course the work that an electric motor does in a mine it will do in a mill. There are several reasons why the universal adoption of electric motors in distributing power around large factories may be confidently expected. In reality, the change began long ago. At its Schenectady and Lynn factories, employing between them over seven thousand men, the General Electric Company distributes power in this manner to the different shops and lines of shafting. The thing is so simple and so economical. The power plant gives just the energy required at each instant for each motor, and the very second a tool is thrown on or off, the generator responds accordingly. Moreover, it is much easier to run a wire than to build lines of jack-shaft and counter-shaft. For shafting, the factory walls have to be strengthened and the belts must either travel through holes or in a special tower with more or less risk of spread of fire. It has also

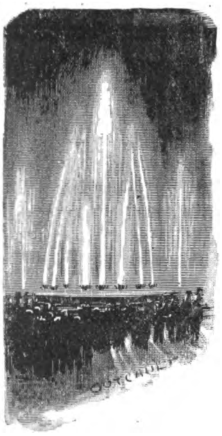
been noted in some factories equipped with electric power that the goods have improved in quality because the driving motors are independent and more closely regulating. The extent to which the idea of electric power in factories has won the day is shown not only in the numerous shops now operated in this way, but by the fact that in Denver a large new building has been equipped throughout on this plan, with a motor in every room, for the benefit of small-power consumers. The great beauty of the electric motor is that a power-user can have one or a dozen or a hundred of them in his store or shop, just as he wishes; so that along the same street one little motor will be running a fan; next door, a freight elevator; and just beyond, a gang of sewing-machines in a shirt or trousers factory. There are nearly one hundred thousand of these "stationary" electric motors in use to-day in the United States, supplied with current from central stations, and they are engaged on every conceivable variety of work. Some of them are as small as one-sixteenth of a horse-power, others run up to fifty and one hundred horse-power, and in every instance they consume current in exact proportion to the demand upon them and the work done. The supply of current for the varied industries of our great cities is becoming as important as the supply of current for light, with the additional fact that while light is not needed more than four or five hours, power and light are needed practically "all around the clock," and thus the central station is on a perpetual earning basis.

The slang of the day has caught up the phrase, "Your trolley's off," as significant of the condition of anybody who is without the ability to go ahead or is making a mistake through being in some way behind the times. As usual, all the force and meaning of the slang is not on its surface. The unparalleled rapidity with which the trolley system of street traction has been resorted to as a means of urban transit in this country is the best proof that could be offered of our modest proposition that electricity is half an American. There is not a city on the face of the earth to-day that has adequate means of rapid transit, but



Electric "Elevated."

Digitized by Google



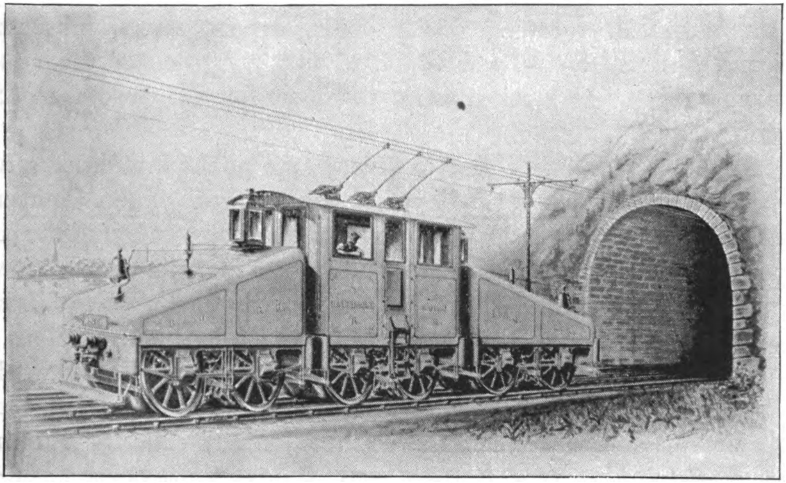
World's Fair Fountain.

it is only in America that the quick wit of the people has seized on the trolley as the solution of the problem and the way out. The great majority of cities and communities are not large enough or rich enough to build and support elevated roads or cable roads. But they have become tired of horse-cars and can afford the trolley system. No sooner had Sprague achieved his historical successes in the East, while Van Depoele hammered away at the difficulties with equal vigor and at half a dozen points in the West, than the campaign of popular rapid transit was won, and all over the land the work of construction began. What has been the result? To-day there are some four hundred and fifty separate electric street-railways in the United States with at least ten thousand electric cars and five thousand miles of track. The General Electric Company, whose patents and apparatus dominate in this field as in all the others, can hardly keep pace with the call for new motors, especially when the contracts run, as they often do, for five hundred or one thousand motors at a time. These electric roads already carry passengers every year equal in number to the population of the world. In scores of cities they carry the whole population, on an average, from one hundred to one hundred and fifty times a year. The trolley is evidently able to survive all the abusive language that has been heaped upon it and to subserve the needs of any community, no matter what its size. It has proved to be eminently safe. No passenger has yet been injured by the current used, and each month witnesses the addition of some new feature of safety and comfort. The street-railway that electricity cannot handle and render profitable must be a rare one. The investment in the industry reaches all the way from the five million dollars that Philadelphia capitalists are now spending on their local trolley system to the fifty-thousand-dollar roads going in by the dozen in every prosperous State between the Atlantic and the Pacific.

The step from surface traction to that on the elevated railroads, such as those of New York; or the underground roads, such as those of London; or the steam roads, such as the terminals in Chicago and

Digitized by Google

Baltimore, is very short. Liverpool is to-day starting her electric elevated road, and a high-speed locomotive is now being built by the General Electric Company for similar work in this country, such as that on the proposed extensions of the Manhattan Railroad, thus giving all the advantages of rapid travel without dust or cinders and with little noise or vibration. Heavier work than that, however, will be undertaken with other and larger locomotives, built by



Electricity on the Steam Roads.

the General Electric Company to handle heavy trains of freight and passenger cars in the new railway tunnel under the city of Baltimore.

It might be thought that these branches of work would exhaust the subject, and they might with any concern smaller than the General Electric Company or any domain smaller than the expanding interests it is identified with. For instance, the topic of electric meters has not been hinted at, and yet the current for every lamp is now being measured and the demand for the meters is illimitable. Electro-metallurgy has been wholly neglected in this brief review, and yet one ton of electrolytic copper is now deposited every quarter of an hour the year through, and machines built by the General Electric Company are doing a large part of the work. Electric navigation—well, Governor Flower, of New York, in his message to the Legislature, proposes that the traffic on the Erie Canal shall be handled by trolley boats; and meanwhile a fleet of General Electric launches are navi-

Digitized by Google

gating the lagoons of the Chicago World's Fair. Electric heating—there is not a central-station manager who does not look forward, even with the appliances already devised, to making this part of his "station load;" and in trolley cars the electric heater is becoming well-nigh as common an object as the incandescent lamps. Isolated plants—so far from central stations and power-houses embracing all the area to be supplied, there are no fewer than six or seven thousand isolated installations, located in office buildings, mills, hospitals, theatres, docks, halls, depots, stores, museums, prisons, gardens, hotels, and the like, and every one of them is a customer of the General Electric Company for one or other of its manufactures.

At the great World's Fair in Chicago the public is afforded a full opportunity of witnessing and appreciating the work of this Company in placing within the reach of all the means of best enjoying the services of electricity. In one place, and for the first time, are gathered together models and machinery showing the growth, exemplifying the perfection attained, and emphasizing the colossal proportions of the industry launched by Edison, Thomson, Houston, Van Depoele, and a host of other inventors whose patents it controls. Not less than sixteen thousand square feet of space in the Electricity Building is covered by this splendid exhibit, which occupies the entire central space and radiates a certain distance down each of the wings of the nave and transept.

The centre of the exhibit is occupied by a triumphal column eighty feet in height. The effulgence of the thousands of Edison lamps hung thereon embodies the very spirit of light. Around this will be grouped specimens of all the different classes of apparatus manufactured by the General Electric Company, showing the evolution from the crude experimental model of only a few years ago to the perfected device of the present day. The most approved style of motors for railway service, the latest and most successful devices for use in coal and metal mines, calculated to render labor therein less arduous and life more secure, machinery for the illumination of our war vessels and cruisers—applications of electricity for the manipulation of the great guns, the hoisting of huge shot and explosives to the gun-breech, the discovery of the enemy's range, and the manœuvring of the vessel itself—and motors for all classes of power

Digitized by Google

work, are there. A special space is also set aside for a display of the different forms of electrical meters and measuring instruments.

The illumination of the greater part of the Electricity Building forms another part of the exhibit and affords an excellent idea of the splendor of the decorative effects which can be obtained by the flexibility of the electric current and the miniature lamps which have recently been invented and are now being made by the Company. These small lamps glow, not only all over the exhibit, but also around the interior of the building, and their variegated colors, blending with the hues of the decorations, scintillating and flashing, produce a scene of singularly striking beauty.

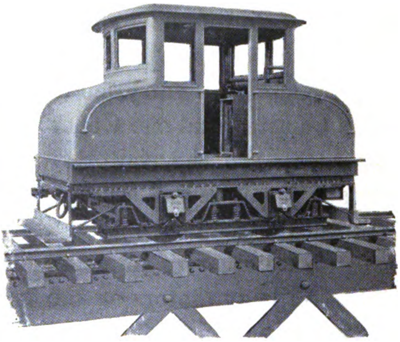
To the General Electric Company was awarded the stupendous task of illuminating the formidable interior of the Manufactures and Liberal Arts Building. The abnormal height of the building destroys the perspective. This, however, is restored by five huge metal crowns or coronas, some eighty feet in diameter, suspended from the trusses and carrying on their edges arc lamps, each of two thousand candle power. Not less than seventeen hundred arc lights are required to illuminate this immense edifice. With the exception of a few lamps, the entire arc lighting of the grounds and buildings of the Fair is also done by this Company.

The illumination of the fountains by electricity at night, metamorphosing the basin in front of the Administration Building into a marvellously beautiful scene from fairy-land, is done by the same master-hand. The one hundred and one General Electric launches—American gondolas—which take the visitor from point to point are propelled by the Company's motors and are operated by its apparatus. The overhead Intramural Railroad is operated by current generated from the General Electric Company's immense fifteen hundred kilowatt dynamos, actuating railway motors of the same make; and last but not least, the entire electrical equipment of the battle-ship *Illinois*, which forms the most complete and splendid naval exhibit ever conceived, is in the hands of the General Electric Company.

Each of these exhibits has its own charm and instruction. "Mix your paint with brains" was the advice once given to a young artist; and this display embodies even more forcibly the lesson that with genius and perseverance the simplest materials may be wrought into objects of permanent utility and supremest beauty. But as a matter

Digitized by Google

of fact the General Electric Company has a permanent exhibit at its branch offices in various parts of the Union, and to these the attention is invited of all who are in any way interested or who wish to obtain information. These offices and depots are maintained in Chicago, Boston, Philadelphia, Washington, Cincinnati, Atlanta, St. Paul, Denver, and San Francisco. And as might be expected of a corporation about to supply apparatus for nearly a score of electric roads in Europe, and with machinery of its make chasing the sun around the globe with the gleam of electric light and the ceaseless hum of electric power, the General Electric Company has to embrace other countries within its sphere of operations. It has special branch offices in Paris and London for the expedition of its business in Europe; and in nearly all the important cities of the world its agents are propagating a lively faith in electricity and the best means of turning it into man's best servant.



Digitized by Google

APPENDIX J.

Digitized by Google

Digitized by Google

(The following correspondence and quotations from published material has been gathered in accordance with the vote instructing the Secretary to print a digest of Massachusetts law relating to the government of electric light corporations, and particularly the powers and responsibilities of a commission like that existing in Massachusetts for harmonizing the interests of electric light and gas companies.—*Secretary.*)

New York, September 19, 1893.

F. E. Barker, Esq.,
Board of Gas & Electric Light Commissioners,
Boston, Mass.

Dear Sir:

You will remember that I proposed at the Chicago Convention to add to our volume of minutes an appendix setting forth the laws under which your Board operates, and also such a summary of the work done as might instruct the members of the Association and assist in multiplying the number of such boards. I believe you said there were some things you would send me bearing upon this question. The report of your talk and the discussion which followed is interesting and would be materially increased in value by such a further statement as I propose.

Yours very truly,
[Sgd.] W. J. JENKS.

Chicago, October 19, 1893.

W. J. Jenks, Esq.,
New York City,

My Dear Mr. Jenks:

* * * * * * *

I am sorry that you should have failed to receive a reply to yours of September 19 and that it seems to have been laid where I cannot find it. I remember, however, the substance of it and hardly know what to say in reply to it.

Our board and its powers, as defined by the statutes, have been things of gradual growth and our jurisdiction could be

Digitized by Google

accurately understood only from an inspection of all the legislation about us passed since the law of 1885. All this you will find in our reports in the several appendices.

What your people wish, I suppose, is to learn about us without being obliged to follow through a series of enactments. Some two or three years ago, Mr. Allen R. Foote, now of Takoma Park, D. C., and formerly Secretary of the other National Association, published a compilation, a sort of composite photograph of the legislation concerning us. It was intended to be in the nature of a comprehensive law such as a legislature might pass if it wished by a single act to create a board with all our powers as they then existed.

I met Mr. Foote here this week and he agreed to forward me some copies, as of course I assisted in preparing it. I shall expect to receive them soon after I get home next week, and will take pleasure in sending you one or more copies of that.

* * * * * * *

Very truly yours,

[Sgd.] F. E. BARKER.

Takoma Park, D. C., October 28, 1893.

W. J. Jenks,

Ass'n of Edison Illuminating Companies,

358 Pearl Street, Brooklyn, N. Y.,

Dear Sir:

On my return from Chicago last evening, I received yours of the 23d. I send you with this two copies of the paper to which you refer. I shall be in New York in about ten days and would like to have a conference with you on questions pertaining to this subject. When shall I look for you?

This paper was published at my own expense; never in any other way.

Yours respectfully,

[Sgd.] ALLEN R. FOOTE.

Digitized by Google

LAW CREATING AND CONTROLLING

THE

MASSACHUSETTS

BOARD OF

Gas and Electric Light Commissioners.

Published by

ALLEN R. FOOTE,

Washington, D. C.

1890.

PRICE, TEN CENTS.

Digitized by Google

Digitized by Google

AN ACT

TO ESTABLISH A BOARD OF GAS AND ELECTRIC LIGHT COMMISSIONERS.

Be it enacted etc., as follows :

SECTION 1. The governor, by and with the consent of the council, shall appoint three citizens of this commonwealth, who shall constitute a board of gas and electric light commissioners, and the governor shall designate the chairman thereof. Said board shall have a clerk, to be appointed by the governor with the consent of the council, who shall keep a full and faithful record of its proceedings, and shall serve such notices and perform such other duties as the commissioners may require, and shall be sworn before entering upon the discharge of his duties.

SEC. 2. One of said commissioners shall be appointed for one year, one for two years, and one for three years from the first day of July, 1885 ; and annually thereafter the governor shall appoint, as hereinbefore provided, one commissioner to serve for three years from the first day of July in the year of his appointment, and until his successor is appointed and qualified. If a vacancy occurs by resignation or otherwise, the governor shall in like manner appoint a commissioner for the residue of the term, and may, with the consent of the council, remove any commissioner for cause after notice and hearing.

SEC. 3. Said commissioner shall be sworn to the faithful performance of the duties of their respective offices before entering upon the discharge of the same, shall not be in the employ of or own any stock in any gas company, or be in any way directly or indirectly interested pecuniarily in the manu-

Digitized by Google

facture or sale of gas, or any article or commodity used by gas companies or used for any purpose connected with the manufacture and sale of gas.

SEC. 4. The annual salary of the chairman of the board shall be $3,000, and that of the other commissioners $2,500 each, to be paid monthly from the treasury of the commonwealth. The commissioners shall be provided with an office in the state house or in some other suitable place in the city of Boston, in which their records shall be kept.

SEC. 5. The board may expend a sum not exceeding $1,000 annually in procuring necessary books, statistics and stationery, and in defraying expenses incidental and necessary to the discharge of their duties; and a sum not exceeding $2,000 annually in defraying the compensation and expenses of their clerk, payable monthly from the treasury of the commonwealth.

SEC. 6. Said board shall have the general supervision of all corporations engaged in the manufacture and sale of electric light or of gas for lighting and for fuel, and shall make all necessary examinations and inquiries and keep themselves informed as to the compliance of the several corporations with the provisions of law.

SEC. 7. Every gas and electric light company shall annually make a return to said board in a form prescribed by said board, setting forth the amount of its authorized capital, its indebtedness and financial condition on the thirtieth day of June preceding, and a statement of its income and expenses during the preceding year, together with its dividends paid or declared, and a list containing the names of all its salaried officers, and the amount of the annual salary paid to each; and said return shall be signed and sworn to by the president and treasurer of said company and a majority of its directors. Every such company shall also at all times on request furnish any statement or information required by the board concerning the condition, management, and operation of the company, and shall comply with all lawful orders of said board.

Digitized by Google

Sec. 8. Every company engaged in the manufacture and sale of gas or electric light shall keep its books and accounts in a form to be prescribed by the board, and the accounts shall be closed on the thirtieth day of June in each year, so that a balance sheet of that date can be taken therefrom and included in the return required by the preceding section, which return shall be for the year ending the thirtieth day of June, and shall be made to the board of gas commissioners on or before the second Wednesday of September in each year; *Provided*, That manufacturing companies in which the manufacture of gas or electric light is a minor portion of their business shall only be required to keep accounts of the expenses and income of their gas and electric light business. The board shall prepare such abstracts of the returns as it shall deem expedient, and shall transmit said abstracts, together with its annual report, to the secretary of the commonwealth on or before the first Wednesday of January in each year, to be laid before the general court. Three thousand copies of said document shall be printed for publication and distribution as one of the series of public documents.

Sec. 9. Every gas or electric light company shall have an office in the city or town in which its works are located and shall keep in said office all the books and papers now required by law to be kept within the commonwealth, and also such books as may be required to show its receipts and expenditures, and its indebtedness and financial condition; and shall at all times, upon application, submit its books to the inspection of the board.

Sec. 10. Upon the complaint in writing of the mayor of a city or the selectmen of a town in which a gas or electric light company is located, or of twenty customers of such company, either of the quality or price of the gas or electric light sold and delivered by such company, the board shall notify the company of such complaint by leaving at their office a copy thereof, and shall thereupon after notice give a public hearing to such petitioner and such company, and after said hearing may order, if they deem just and proper, any reduc-

Digitized by Google

tion in the price of gas or electric light or improvement in quality thereof; and they shall pass such orders and take such action as are necessary thereto, and a report of the proceedings and the result thereof shall be included in their annual report to the legislature.

Sec. 11. Upon the petition in writing of any person who has a residence or place of business in a city or town where a company is engaged in the manufacture and sale of electric light or gas for lighting or for fuel, and who is aggrieved by the refusal or neglect of such company to supply him with gas or electric light, the board of gas and electric light commissioners shall have authority to issue an order directing and requiring such company to supply such person with electric light or with gas for either of said purposes, upon such terms and conditions as are legal and reasonable. Said board shall not issue its order under this section except after notice to such company, directing it to appear at a time and place therein named, to show cause, if any there be, why the prayer of such petition should not be granted.

Sec. 12. In any city or town in which a gas company exists in active operation no other gas company nor any other persons shall dig up and open the streets, lanes, and highways of such city or town for the purpose of laying gas pipes therein without the consent of the mayor and aldermen or selectmen of such city or town after a public hearing before said mayor and aldermen or selectmen and notice to all parties interested by publication or otherwise.

Sec. 13. The board shall from time to time ascertain with what degree of purity the gas companies can reasonably be required to make and supply gas; and if any change in the existing laws regarding purity in gas shall be, in their opinion, desirable or expedient they shall so report to the legislature in their next report.

Sec. 14. Nothing in this act shall affect the office of gas inspector as constituted by chapter sixty-one of the Public Statutes, excepting that said inspector shall whenever requested

Digitized by Google

by the board give to them such information and assistance as they may require, consistent with the duties of his office.

SEC. 15. In any city or town in which a company is engaged in or organized for the purpose of the manufacture and sale of electric light no other company shall lay or erect wires over or under the streets, lanes, and highways of such city or town for the purpose of carrying on its business without the consent of the mayor and aldermen of such city or selectmen of a town after a public hearing and notice to all parties interested.

SEC. 16. The board, whenever any gas or electric light company violates or neglects in any respect to comply with the provisions of any law, or refuses or neglects to comply with any lawful order of the board, shall give notice thereof in writing to such corporation, and to the attorney general, who shall take such proceedings thereon as he may deem expedient.

SEC. 17. Any court having jurisdiction in equity, in term, time, or vacation, may, on the application of said board, by any suitable process or decree in equity enforce the provisions of this act and the lawful orders of said board.

SEC. 18. The board shall make an annual report of its doings to the legislature in January, with such suggestions as to the condition of affairs or conduct of the gas or electric light companies as may be deemed appropriate.

SEC. 19. Any company or person aggrieved by the decision of the mayor and aldermen of a city or selectmen of a town under the provisions of sections twelve or fifteen of this act may appeal therefrom to said board within thirty days from the notice of said decision, and said board shall thereupon give due notice and hear all persons in interest, and its decision thereon shall be final.

SEC. 20. The board, upon application in writing by any company organized or chartered under the laws of the commonwealth for the purpose of making and selling gas for

Digitized by Google

illuminating purposes, may, after such notice and hearing as said board shall deem proper, authorize said company to engage in the business of generating and furnishing electricity for light and power in all or such part of the territory in which it is authorized to supply gas as said board may designate; *Provided, however*, That said company shall not engage in said business so authorized unless by vote of two-thirds of the stockholders, representing not less than two-thirds of the stock, at a meeting duly called for that purpose. Said company so authorized shall file in the office of the secretary of the commonwealth a certificate of such addition to the business, as provided in section fifty-one of chapter one hundred and six of the Public Statutes.

SEC. 21. Said board shall, at the time of granting said authority, prescribe the time, not exceeding six months, within which said company shall erect and equip such a plant for generating electricity for light and power as may be required in the specified territory, and designate the minimum capacity of such a plant; and, if said company shall neglect to erect and complete said plant within the time prescribed, said authority shall thereupon become void, and no such authority shall be again granted to said company within two years thereafter; *Provided, however*, That said board may, for cause shown, extend the time first prescribed for erecting and equipping said plant not more than three months from the expiration of the time first prescribed,

SEC. 22. At the expiration of the time and extension thereof, if any, given under the preceding section, said board shall, after such examination as they shall deem proper, make, in a book kept by them for that purpose, a record as to whether their orders with reference to the erection and completion of said plant have been complied with. Said record shall be conclusive evidence of the truth of the matters stated therein.

SEC. 23. Said company so authorized, except in cases of the purchase or lease of the property, licenses, rights, and franchises of some electric light company as authorized under

Digitized by Google

section twenty-six of this act, shall not erect or maintain any poles for the support of wires, nor erect or maintain any wires in, through, or over any streets or highways, nor dig up any streets or highways for the purpose of laying said wires underground, until it has (upon petition in writing by said company) first obtained the consent in writing of the mayor and aldermen of cities or selectmen of towns in which said streets are located.

Said company, having obtained such consent, may, under the direction and control of the mayor and aldermen or selectmen, dig up and open the grounds in any streets and highways, so far as is necessary, for the purpose of laying lines of wires to carry into effect the authority given under this act, and for the purpose of keeping said lines in repair, and to erect and maintain lines of wire upon or above the surface of such streets and highways.

The said company shall put all streets and highways which are opened into as good repair as they were in when opened, and after failure so to do within a reasonable time, shall be deemed guilty of a nuisance.

Sec. 24. Gas companies, as representing the business in which by this act they are authorized to engage, shall be subject to the control of the board in the same manner and to the same extent they now are or hereafter may be respecting the business of furnishing gas.

Sec. 25. Except as hereinbefore expressly provided, gas companies shall (in exercising the powers conferred by section twenty) have all the powers and privileges, and be subject to all the duties, restrictions, and liabilities set forth in all general laws which are now or hereafter may be in force relating to companies engaged in the transmission of electricity for light or power.

Sec. 26. Said gas companies so authorized by the board shall have the right to purchase or to lease, and to use all or any of the property, licenses, rights, privileges, and franchises of any electric light company engaged in the business of fur-

Digitized by Google

nishing electric light or power in the territory in which such gas company may be authorized to furnish such light and power.

Sec. 27. The provisions of the seven preceding sections shall apply to electric light and power companies.

Sec. 28. Any gas company in this commonwealth, whether furnishing gas under the provisions of general laws, or of any special charter or of any contract with any city or town, may apply to the board of gas and electric light commissioners to fix and determine the price of the gas to be thereafter sold and delivered by said company, or to revise any former order or action of said board in regard to the quality or price thereof. Said board after such notice as it shall deem expedient shall give a public hearing on such application to the petitioner, and to the city or town, and such other persons interested as may desire to be heard, and thereafter may pass such orders and take such action in regard to the subject-matter as it may deem just and reasonable, and the orders and decrees of such board in relation to the price and quality of the gas thereafter to be furnished by said company shall be thereafter binding upon all parties until further order of said board.

Whenever, pursuant to section ten, the said board has ordered a reduction in the price of gas or improvement in quality thereof, the maximum price fixed by such order shall not be increased by the company named therein, except in the manner herein provided.

Sec. 29. All companies and individuals engaged in the business of manufacturing and selling gas or electricity for light or fuel shall make a written report within twenty-four hours to the board of gas commissioners of every accident caused by the gas or electricity manufactured or supplied by them, whereby an employe or any other person shall suffer bodily injury, or loss of life, or be rendered insensible, stating the time, place, and circumstances of the accident, and such other facts in relation thereto as the board may require; and the board shall present in its annual report and abstract of all

Digitized by Google

such cases. The board shall personally investigate all cases which it may deem to require investigation.

Sec. 30. The annual expenses of the commissioners and clerk, including salaries, shall be borne by the several gas and electric light companies, in proportion to their gross earnings, and shall be assessed and recovered in the manner provided for the assessment and recovery of the expenses of the railroad commissioners.

Sec. 31. In the construction of this act, the terms "company" and "companies" shall be deemed to include also all corporations or individuals engaged in the business of manufacturing and selling gas or electric light within this commonwealth.

Sec. 32. This act shall take effect upon its passage.

Digitized by Google

Digitized by Google

APPENDIX S.

Digitized by Google

Digitized by Google

Digitized by Google

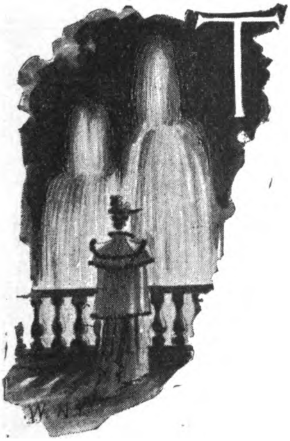
PRESS OF McILROY & EMMET,
36 Cortlandt St., New York.

Digitized by Google

THE GENERAL ELECTRIC COMPANY AT THE WORLD'S FAIR.

BY JOHN McGHIE.

(*Electrical World, Sept.* 23, *1893*.)



THERE have been given on several occasions in the past in the columns of *The Electrical World* detailed descriptions of parts of the magnificent and comprehensive exhibits which the General Electric Company has made at the World's Fair, both within the walls of the Electricity Building and elsewhere at the Exposition. But whereas hitherto only detached portions of this exhibit have been described, it is now the purpose to consider it as a whole.

It will be remembered that when the Exposition was first projected the General Electric Company was invited to participate; and, feeling that it occupied the position of the largest electrical company in the world, it decided to make the largest and most varied display of all at the Fair. That it has succeeded in getting together a really striking and comprehensive exhibit even the most prejudiced will admit.

It was only late last fall that the space now occupied by the General Electric Company was allotted to it; but the work of installation was pushed forward energetically, and the exhibit was ready at about the time the Fair was declared open. The entire central part of the Electricity Building is occupied by its display, which covers the whole space in the transept from the east to the west door, and stretches down the nave on either side. On either hand, immediately under the galleries, the space adjoining the central areas was also assigned to the General Electric Company, thus securing to it over one quarter of the ground floor of Electricity Building, and, at least, one-seventh of the entire available space.

In addition to its exhibit, in the proper acceptation of the term, the work which the General Electric Company has done in connection with the Exposition forms in itself a superb display, transcending in diversity and splendor everything previously attempted at any other exposition in this country, or, indeed, in any other. This includes the wonderful Stieringer Electric Fountains, the Intramural Railway, the Pier Movable Sidewalk,

Digitized by Google

the entire Exposition motor equipment, the Electric Launch service, the battleship Illinois, the greater part of the outside arc lighting, the lighting of the great interior of the Manufactures and Liberal Arts Building and various minor applications.

The fountains have already been described and illustrated (*The Electrical World*, Jan. 21 and May 13, 1893). It suffices to say here that they constitute one of the greatest and most pleasing attractions at the Fair in the evening, and form a souvenir which every visitor will carry away to live in his mind for the remainder of his days The result of their operation with the maximum of light and the maximum of water is beautiful almost beyond conception ; and, as the great streams of water rise and fall, suffused with the iridescence of a thousand hues in combination, the delighted people, congregated on each side of the great basin, in front of the Administration Building, and upon the canal bridges, loudly express their appreciation.

The next important work undertaken by the General Electric Company—the Intramural Railway—was fully described and illustrated in *The Electrical World* of May 6. This road now runs almost all around the grounds. Constructed after many of the Fair buildings had been erected, and compelled by the condition of things to be as unobtrusive as possible, its course is not only circuitous, but has more grades and curves in its short length than any other elevated railroad of a similar length in the world. Its northern extremity is just north of the north end of the great Manufactures and Liberal Arts Building, where it passes in a loop over the north branch of the Lagoon, the station at this point giving access to both sides of the Lagoon and the Fisheries and Government buildings. Thence the road passes north through the group of foreign buildings, close to the German, Russian, Haytian, French and Swedish buildings, then east of the Art Palace, passing close to the Vermont, Massachusetts, Connecticut, New Jersey and Iowa State buildings. It then turns to the west, passing along the north side of the grounds, giving a fine view of the State buildings, as well as the Art Palace.

Turning to the south at the northwest corner of the grounds, a glimpse is obtained from the cars of the curious Esquimaux village ; and at 57th, 59th and 62d street entrances the road connects with the stations immediately over the gateways. In passing to the west side of the grounds, the passenger has a fine view of the California Building, Woman's Building, Horticultural Building and Choral Hall. The track continues behind the Service Building over the roof of the Transportation Building, and connects directly at the joint station, with the Chicago

Digitized by Google

South Side Rapid Transit Railroad, or "Alley L," thus providing good facilities for travel over the South Side.

From this point the road passes over the tracks of the steam roads, and connects at the Terminal Station with all the roads that enter the Fair Grounds; then around the west end of Machinery Hall to a station between the Colonnade and the Stock Exhibit Pavilion, whence a fine view, limited by the great dome of the Illinois State Building and the Art Palace, may be had through the heart of the Exposition to the north end of the park.

Thence the road turns southeast, past the Agricultural Building, the Great White Horse Inn, and the Cliff Dwellers to the power house of the Intramural Railway, where the electricity for the operation of the road is generated.

The road then takes a northerly direction and passes between the Forestry Building and the Ethnological Building, where there is a station for the accommodation of visitors to these two interesting exhibits, thence between the Dairy and the Shoe and Leather exhibits, until the Krupp exhibit is reached. The station at this point forms the southern terminus, situated in the loop which surrounds the Indian School exhibit.

Considerable interest in this road is manifested, not only by the engineering and electrical fraternity, but also by the lay public, which has not allowed this excellent opportunity to pass by of seeing and witnessing what is the highest degree of perfection yet attained in electrical railway work, and the only solution of the rapid transit question not open to the usual objections. The officials of the Intramural Railway are instructed to receive all visitors and show them all that is to be seen, and it may be safely said that no visitor to the Exposition omits to visit the railway in general and the power house in particular.

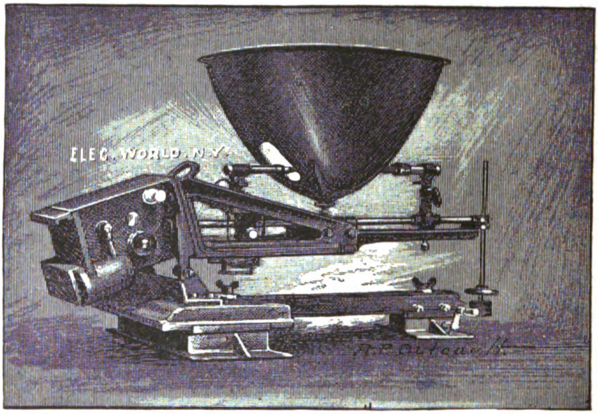
This power house contains the most complete single exhibit of moving machinery at the Exposition. Upon its floor the General Electric Company has congregated samples of its multipolar generators of various capacities, both belt driven and direct connected, and practical railway men are thus able to consider the merits of both systems. The place of honor is, of course, given to the great 12 pole, 2,100 H. P., 1,500 K. W. direct connected multipolar generator, which towers a colossus of a new industry, a tamed Titian of traction, above the lesser machines which are grouped on either side of it. The dimensions of this machine, are as follows:

Weight of field magnets	80,000 lbs.
" " armature	73,600 lbs.
" " commutator	12,400 lbs.
" " dynamo, complete	181,000 lbs.
" " shaft and hub	56 tons.

Digitized by Google

Weight of fly wheel	85 tons.
Diameter of generator	15 ft. 0¼ in.
Breadth of generator	3 ft.
Diameter of armature	10 ft. 6 in.
Breadth of armature	3 ft. 3¼ in.
Breadth of flywheel	2 ft.
Diameter of flywheel	24 ft.
Thickness of rim of flywheel	1 ft 10 in.
Diameter of commutator	7 ft. 6 in.
Diameter of shaft	2 ft.

Another machine in this power house which merits attention is the 750 K. W. multipolar dynamo, directly connected to a Lake Erie engine. With this combination the entire twelve trains on the road, running during the 18 hours of service, were operated for some little time without aid from any other machine. This



A FOUNTAIN ARC LAMP AND PROJECTOR.

showing is phenomenal, and speaks highly of the efficiency of the design and construction of both dynamo and engine.

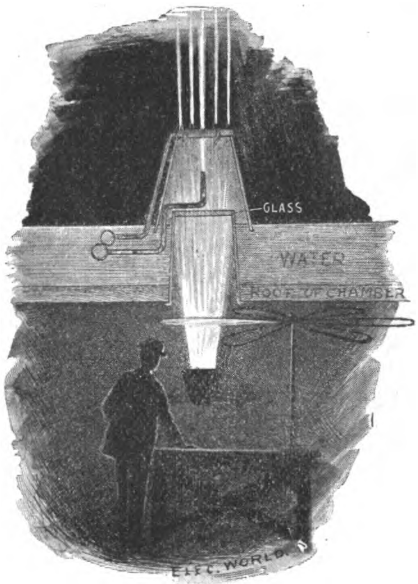
Facing the great dynamo is the enameled slate switchboard framed in mahogany. It is composed of five panels, one for each machine, each panel containing all the instruments necessary for the control of the machine to which it belongs, *i. e.*, triple pole switches, shunt rheostats, ammeters, automatic circuit breakers, lightning arresters, lightning switches, etc. The circuit breakers are of the new design of the General Electric Company, and are provided with automatic resetting devices, which close them electrically. With this electrical reset, all or any desired number of circuit breakers in the station can be reset at once. The generators are adjusted so to run in perfect harmony as exactly to divide the load in proportion to their

Digitized by Google

relative capacities—a nice problem with generators of such varied sizes and types.

The transportation service is effected by trains running at four-minute intervals, each train consisting of a motor car and three trailers; the trains weighing 63 tons each, seating 280 people, and the cars being of the same length as those generally used on elevated roads—about 45 feet from end to end. The weight of these trains, as compared with a train drawn in the usual way by a locomotive, shows a saving of about 20 tons dead weight.

It has been found that the amount of power required to run



FOUNTAIN PROJECTOR.

this road was considerably less than that provided, but the General Electric Company, preferring to subject itself to no chance mishap or unforeseen contingency, put in an excess of power. As at present equipped the road is equal to any emergency. Its operation is as perfect as electrical and engineering skill could devise, and the public desire expect. On July 4th it carried not less than 63,000 passengers, and during the month of June over three-quarters of a million.

The Pier Movable Sidewalk was devised to convey passengers from the boats to the grounds. It runs from end to end of the pier, and breaks into a loop at either end. The walk moves

Digitized by Google

continuously in one direction, and is divided into two sections, the outside moving at three miles an hour, the inside section at six miles an hour. No difficulty is experienced in stepping on to the outer running platform from the stationary one, and another step places the passenger on the faster moving platform where he takes his seat and is carried along to his destination, when he alights with as little difficulty as he took his place. The track is elevated a few feet above the level of the pier, and is surrounded by a stationary platform railed in. Every thirty-fifth truck is equipped with two General Electric motors. Each truck is 12 feet 6 inches long, having a wheel base of 5 feet 9 inches. The gauge of the track is 45 inches, and the truck wheels 18 inches in diameter. The width of the platform is 36 inches. The six-mile-an-hour platform is also composed of trucks 12 feet 6 inches long, and carries seats for the passengers. This is propelled by means of a flat band of steel four inches deep and half an inch thick, which, resting on the rims of the truck wheels, moves along twice as rapidly as the trucks themselves and carries the faster platform with it.

The motors are "G 30" four-pole, double reduction motors of the General Electric Company, rated at 15 H. P. each, The conductor is strung under the platform on special oil insulators, and contact is made with an over-running trolley dependent from the truck. The endless steel band serves as a return circuit. The total weight of the train is 918,000 pounds, and the 10 motor trucks 12,000 pounds each, making a total weight of 1,038,000 pounds. Three hundred H. P. are provided to run this train, but two hundred H. P. suffice. The road is operated by the Multiple Speed and Traction Railway Company.

The next great feat of the General Electric Company is the lighting of the interior of the Manufactures and Liberal Arts Building with its arc lamps. The immensity of this building, in which might be placed several regiments of cavalry and infantry, is such that any plan of lighting dependent upon upright supports was doomed to failure. Still it had to be lighted, and the perspective restored at the same time. Mr. Stieringer, the designer of the Fountains and the Tower, elaborated a scheme which has proved once more his claim to originality of conception and power of design. The space to be lighted is the interior of a building, which in the clear measures 1,276 feet long by 380 feet wide by 237 feet high, and the task outlined has been successfully accomplished. Pendent from the great girders of the roof are five great coronas of iron suspended by steel cables, and carrying arc lamps arranged in star form on the outer edge. The largest corona measures 75 feet across, and is suspended in the exact centre of the building. This is flanked on either side above the central aisle by four others, the diameter of each of which is not less than 60 feet. The greater

Digitized by Google

corona carries on the inner and outer star points 102 10-ampere arc lamps, each of 2,000 C. P.; the smaller coronas are each hung with 78 lamps of the same candle power—in all 414 arc lamps with an aggregate of 828,000 C. P., blazing from a height of 140 feet from the floor over the stupendous collection of wonders within the stately walls. The lamps are thoroughly insulated by passing the lamp cables through rubber insulators on the davit arms. They are run on circuits of 50 lights each. As auxiliary to this great lighting feat there is also a number of additional arc lamps used for the lighting of the galleries and lateral aisles. The total number of General Electric arc lamps employed in the illumination of this building is 1,098—as many as would be needed to illuminate the streets of some great city. The lamps are operated from the Thomson Houston arc light plant in Machinery Hall. The ironwork of the coronas was constructed by the Pittsburgh Bridge Company, of Pittsburgh, Pa., and never were electroliers of proportions so huge made before in the history of the fixture industry.

The other open air exhibits of the General Electric Company are the Electric Launches and the great Search Light. The popularity of the former is attested by the very palpable profit daily accruing in the coffers of the operating company. The launches skim silently and swiftly over the placid waters of the basins, canals and lagoons, propelled by an unseen power, which emits no smoke nor noise of steam. They are always crowded, evenings as well as in the broad day, and are resorted to as a means of viewing the imposing architectural beauties from the water level as opposed to the view from the second story which is obtained from the Intramural road. There are 50 of these little electric waterflies, carrying hidden from view of the passengers the batteries and the necessary motors. The charging station is south and east of the Agricultural Building. Here the launches are moored, the connections made, and the charging from the group of four No. 60 Edison dynamos in Machinery Hall proceeds silently through the night, until each has received enough of the fluid pabulum to permit it to run for 11 or 12 hours without another meal—*i. e.*, about 40 H. P. hours of electrical energy. The motors are of a design especially made by the General Electric Company to be run in connection with the storage batteries of the Consolidated Storage Battery Company in the launches of the General Electric Launch Company. The electric launch, when first placed upon the lagoons, was a mere experiment in this country ; to-day it is an everyday object, no longer exciting surprise, and soon we shall expect to see as many electric launches disporting themselves on the waters of the Hudson or Schuylkill as are to be found darting up the reaches of old Father Thames by Richmond way.

In the great Search Light the General Electric Company has an

Digitized by Google

exhibit which is as unrivaled in its own field as are the other features mentioned in theirs. This immense eye is 10 feet 6 inches high to the upper side of the ventilator, and has a total weight of 5,500 pounds. The reflecting lens mirror, of the Mangin type, is 60 inches in diameter—as perfect a spherical concave mirror as can be made by human hands and perfected machinery. This mirror, 3¼ inches at the edge and 1-16 of an inch at the centre, weighs 700 pounds. It is mounted at the end of the huge drum, and looks upon the automatic six-foot arc lamp, which carries a positive carbon 22 inches long and 1¼ inches in diameter, and a negative carbon 15 inches long and of similar diameter. The maximum amount of current required is 200 amperes and the luminous intensity of the lamp 90,000 to 100,000 candles, which, it is calculated, is increased in reflection to an estimated intensity of 375,000,000.

This great Search Light is erected on the colonnade between the Agricultural and Machinery buildings and its splendid beam shoots up over the canals between the Electricity and Manufacturers buildings, passes over the Illinois Building, making it appear of spectral whiteness, and loses itself in the obscurity beyond. This search light has no points to receive from the excellent search lights which Germany has sent over. It is of home production, and in perfection of operation equal, if not superior, to anything in its line made here or elsewhere.

Many other search lights of General Electric manufacture are shown in Electricity Building and on the battleship, each and all attesting the superiority of American ingenuity and workmanship.

The work of General Electric motors is evident all through the Fair. During its construction these motors were universally used in place of the steam engine for hoisting the great iron girders and trusses into place, for running sawmills, pipe cutting and threading machines, planers, sewerage and water pumps, painting machines, etc. The entire motor system of the World's Fair, comprising every motor used by the Exposition, between 1 and 135 H. P., has been furnished by the General Electric Company, and these useful and busy little machines are met with in every one of the architectural wonders of the Fair.

In Machinery Hall is to be found the great heart of the General Electric system as laid down at the Fair. The plant installed there may be divided into the low pressure incandescent system and the arc lighting system. The principal feature of the former is the two 400 K. W. multipolars, directly connected to a triple expansion engine. The efficiency of these generators is attested by the work similar ones have done in the New York station. The engine designed by Mr. J. C. Henderson for 800 H. P. at maximum economy will easily give 1,500 H. P. under emergency. The Chicago Edison Company is to have a duplicate

Digitized by Google

of the set shown here, and it is calculated to maintain light over an installation of 25,000 lamps. Near to this machine—the largest type of direct connected, direct current lighting generator—is shown the smallest—a four-pole 2 K. W. generator driven by a Case engine. In addition this plant comprises a 45-K. W. multipolar directly driven by a G. G. compound Willans engine. From this is distributed the current for the incandescent lights around this plant, and the search lights on the Music Hall, Casino and Electricity Building.

Immediately in front of these machines are four 150 K. W. General Electric bipolar dynamos, giving current for the electric fountains and the launches. And a little to the side is a switchboard, which is perhaps the most compact of its kind ever constructed. It carries all the switches for the different machines just enumerated, 4,000 ampere switches being used for the large 4 o K w. generator, ammeters, voltmeters for each dynamo circuit, ammeters and potential indicators for each feeder circuit, of which nine run from the board. The lower left hand corner of the board is used for a no-current circuit breaker, which, used on the feeder for the launches, prevents the reversal of the dynamo by the united electromotive force of the batteries.

At the western end of this plant is the arc lighting exhibit of the General Electric Company, consisting of 27 Thomson-Houston and six Excelsior machines, all of standard design. From the former run the circuits for the great coronas in the Manufactures Building, and the latter are used for the Horticultural Building. Both plants also supply current for considerable outside lighting. The wires from the machines are carried to the 40-circuit arc switchboard, which is a remarkable piece of switchboard design, perfect in operation and workmanship. In the rear of this are two marble boards on which are mounted the controllers for the Thomson-Houston arc machines. The entire plant is driven by a low speed engine with Corliss valve gear.

The north aisle of Machinery Hall is spanned by the electric travelling crane from the Morgan Iron Works, operated by seven General Electric motors. It is the completest electric traveling crane ever built, and is under easy control by the operator in the cage at one end. Near the centre of the aisle are two 135 H. P. General Electric motors belted to the countershafting.

Coming now to Electricity Building, the exhibit proper of the General Electric Company will be easily accorded the palm for variety and extent. It covers the entire field of electrical research outside the special regions of telegraphy and telephony.

The south centre space is devoted to a complete exhibit of Thomson-Houston and Edison motors, all fully equipped with the accessory apparatus for their stopping, starting and speed

Digitized by Google

regulation. Between the two lines of motors are the special motor applications, such as factory trucks, launch motors, electric drills with flexible shaft, derrick and ventilating fans. The derrick is always a centre of attraction for a large crowd. It is of five tons capacity and is fitted with a lifting magnet of 2,000 pounds. A platform capable of carrying 14 to 16 people stands beneath the magnet. Placing the magnet on the keeper attached to the platform, and energizing it allows the motor on the derrick to lift the entire load. As soon as the current is shut off from the magnet the platform drops.

Beyond the motor exhibit is the railway exhibit of the company, consisting of its multipolar ironclad railway generators of the belted types, the new panel switchboards devised by the General Electric Company, and several trucks carrying the most modern motors. Among these is the new type G. E. 800 motor on a Bemis truck, the type W. P. 30 on a Taylor truck with Genett air brake, the type W. P. 50 on a Robinson radial truck, and the type L. W. P. 20 as used on the Intramural Railway on a Jackson & Sharpe truck with the Griffin Car Wheel Company's wheel. The latter truck is shown complete with its air-brake equipment as supplied on the Intramural Railway by the New York Air Brake Company. On the showboard covering the reverse of the switchboard is shown a diagram of car wiring as practiced by the General Electric Company in its series parallel system There are also shown a complete set of overhead parts as used in the construction of the present day. Over the entire exhibit extends a double track, double bracket trolley system with a crossing at right angles. The entire construction, ornamental in character, is intended to appeal to those in the community who have an antipathy against the unsightliness of overhead wires.

In the east centre space is the marine exhibit of the General Electric Company, including direct-connected generator, four-winch hoist, search light projectors and all the electric light fittings peculiar to merchant marine or man-of-war service. The Stanley-Kelly two-phase system, with General Electric generator especially designed for this service, is also here shown, as well as alternators of direct and belt-driven types. Towards the centre of the building in this space is shown a collection of models and special experimental high potential apparatus designed by Prof. Elihu Thomson, of the General Electric Company.

In the north centre space is collected the Edisonia of the company. The Jumbo machine, after 11 years of continuous service, was taken out and kindly loaned to the General Electric Company by the New York Illuminating Company for this display. It would be interesting to know the total earnings of this machine, gross and net, for the stockholders of the New

Digitized by Google

York Illuminating Company. To the north of the Jumbo is a complete display of the three-wire system with all the material needed therefor. Adjoining this is a set of machines supplying current for the quadruplex telegraph service of the Western Union and Postal Telegraph companies reaching out from the World's Fair to all the various points accessible without retransfer. A switchboard in connection with this plant enables the telegraph company to take off positive and negative potentials of any desired degree up to 350 volts.

The lamp exhibit of the Edison lamp factory is the first complete commercial exhibit ever attempted of the incandescent lamp. It is remarkable in showing the number of varieties of lamps that are in commercial use at the present day, there being 2,500 commercial lamps in the exhibit, no two of which are alike. The patent exhibit is also of interest. The space at the north end contains an exhibit peculiarly fitted as a background of the Edison lamp exhibit, being an enormous fan studded with over 1,300 incandescent lamps.

In the west centre space is the power transmission and mining exhibit of the General Electric Company, in which is shown in full the three-phase system of power transmission, including a very interesting series of transformations of energy. In the centre of the exhibit stands a deep mine triplex pump of 500 gallons capacity for a lift of 650 feet, moved by a 100 H. P. 220-volt electric motor The motor derives its energy through the transformations of fuel, boiler pressure, engine and dynamo with transmission from Machinery Hall on the Edison three-wire system. The triplex pump delivers the water under the head mentioned against a Pelton water wheel, which, at 750 revolutions, delivers its power to the armature of a 35 K. W. three-phase electric generator, the armature of the generator being on the same shaft as the paddles of the Pelton wheel. From the three-phase generator the current is conducted to a set of step-up transformers, having a ratio of 20 to 1 and transmitted across to the mining space on three No. 18 wires, where step-down transformers reduce the potential to 110 volts. At this potential the current is used to light 500 incandescent lamps arranged equally on each of the three branches of the three-phase circuit; to three series of arc lamps arranged two in series with resistance across each of the three legs of the three-phase circuit; and to a series of three-phase motors from 3 to 15 kilowatt capacity. In addition to this system is shown a synchronizing system, the alternating current generator driven by a direct current motor being on one side of the exhibit space, the alternating current motor being located on the other side of the exhibit space The direct current motor driving the alternating current generator is in fact a motor transformer having on one side a direct current commutator and on the

Digitized by Google

other side the three-phase commutator, and is used as either a direct current or three-phase motor, or as a motor transformer at the will of the operator. The transmission of high potential by the three-phase system and the transformation into low tension direct current for distribution for general service are here very successfully accomplished.

In the rear of this exhibit, and on the west side of the building, but in the same exhibit space, is shown mining apparatus, including locomotives from 20 to 80 H. P., from 18 to 36 inch guage, pumps of various styles and capacities, hoists, electric air compressors, reciprocating and prospecting drills. No other company on the face of the earth but the General Electric Company could get together an exhibit of so much special electric mining apparatus as is here shown, and none has a record of so satisfactory a service of similar types of apparatus.

The central space of the building is given up to a tribute to the Edison lamp. The tall shaft extending almost to the roof, with a colonnade about the base, is here modeled after the German tower of Victory. The lower space about the colonnade is given to the exhibit of the Phoenix Glass Company, where they show exclusively crystal and glassware for electrical purposes. The entire lighting was designed and installed by the General Electric Company, the Phoenix Glass Company furnishing all the glassware and fixtures. Above the cornice, studding the dome, between the exterior of the colonnade and the central shaft, are ribs of 5 C. P. incandescent lamps in various colors. Arising from the centre of this dome, 10 feet in diameter at the base, is the central shaft studded in vertical and zigzag lines with thousands of incandescent lamps, which in connection with commutating switches, located within the tower, can be made to flash and reflash in a manner that delights all spectators Around the cap, in incandescent lamps, on each of the four sides are the words "Edison Light." Above the capital surmounting the shaft is a mammoth incandescent light, made of thousands of pieces of crystal, illuminated within by numbers of small-sized incandescent lamps, bringing out a beautiful play of prismatic colors. Surmounting the shaft and next to the ceiling in series incandescent lamps is the name "General Electric Company." By means of a reactive coil this is dimmed one moment and the next moment caused to blaze out at full candle power.

Adjoining the central spaces and under the southwest corner of the gallery are the offices, reception and meter rooms of the General Electric Company. The meter room contains a peculiarly attractive display of decorative incandescent lighting, the ceiling and frieze being wrought out in lamps varying from 1 to 32 C. P., and of many varying colors. All classes of meters —chemical and mechanical, voltmeters, ammeters. potential indicators, etc., used for isolated plants and for central station

Digitized by Google

work—are shown. Many of the wattmeters are wired up to the loads throughout the Electricity Building, and lamps in this meter room, and thus the meters, acting under progressive loads, can be shown.

Under the southeast gallery space is shown the arc lighting exhibit of the General Electric Company. This consists of a working plant driven by a 200 H. P. Edison motor, the largest motor ever installed. It is directly connected to shafting under the floor, from which are belted Thomson-Houston arc machines from 50 to 3 lamps capacity. The motor itself is so provided with field and starting rheostats that it can start safely under the heavy load of shafting, belting and machines, and the speed can be regulated to a nicety, the arc machines being kept at the speed necessary for proper regulation. The latest types of lamps, with lamp parts, machine parts and supplies of all kinds, including carbons, are shown in this exhibit.

Directly opposite, under the northwest gallery space, is located the isolated lighting exhibit of the General Electric Company. As a background, a full line of house supplies, chandelier cut-out, fuse blocks, cut-outs of all kinds, snap switches of all capacities, sockets of all classes, with switches of all capacities up to 1,500 amperes are artistically mounted on showboards. About the space are the most modern, direct connected engines and dynamos, triple expansion and compound. This exhibit alone is one worthy of a large manufacturing company.

About the central space hanging from suspension arms are four 4-000 C. P. arc lamps of highly ornamental character ; also several ornamental lamp posts with special lamps.

Hanging on the trusses surrounding the exhibit are constant potential Knowles arc lamps of special finish suited to assembly halls, hotel hallways, corridors and large interior places of public concourse.

The work of the General Electric Company can also be seen in the Industrial Iron Works transfer table, Transportation Building, which has installed over 52,000,000 pounds of freight, including all the Pullman trains and large locomotives in this building. The transfer table is worked by a single W. P. 50 General Electric motor, the system of clutches and brakes being the work of the Industrial Iron Works. General Electric motors can also be seen in Machinery Hall, Transportation Building, Woman's Building and in several of the State buildings where they are used for the operation of passenger elevators of various types.

The equipment of the battleship Illinois has been effected by the General Electric Company in accordance with the usual high standard required by the Navy Department, and used by this company in the installation aboard all the cruisers of the new navy. Commencing with the ill-fated Trenton, every ship of

Digitized by Google

the old navy in American waters, and every ship without exception of the new navy, has been equipped by the General Electric Company. The equipment aboard the Illinois consists of two cross compound, vertical marine type Edison engines, directly driving 16 K. W. ironclad generating sets. As, however, there is no steam aboard this vessel, these sets are dummies, one of them being wired up to run as a motor and thus make a live exhibit of the dynamo plant. Within the bulkhead is located the true source of energy aboard the battleship. This consists of a motor transformer cf 32 K. W. capacity, one armature being wound for 500 volts, the other for 80 volts, the latter compounded for the usual percentage loss. As power for this ship is drawn from the trolley line of the Intramural Railway, at the north loop it was expected that the fluctuations in the potential would be somewhat violent. The motor is therefore provided with a unique controlling apparatus, consisting of the wall controller as used on arc machines cutting in and out a portion of the field resistance of the motor. By this means a variation in the potential either way is easily compensated for. In addition to this, to overcome more violent fluctuations, there is provided on the dynamo end a storage battery. The latter is in parallel with the shunt winding of the dynamo so that ordinarily with the dynamo running at full potential the batteries are being charged, while in case of a large drop in potential the battery discharges, strengthening the series field and also supplying current to the lamps. The batteries also are used to supply the lighting system of the battleship direct through the intervention of a change-over switch. The latter course is resorted to for the night lighting of the ship after the railway plant has shut down.

On the battleship are two projectors, one forward, and the other aft on the bridge, both arranged for automatic control. Both projectors are 30-inches in diameter, provided with horizontal lamp and defracting lenses. In addition, two 30 inch projectors are located on the Casino and Music Hall respectively, serving to light the McMonnies fountain and the facades of the building surrounding the Grand Basin, as well as the dome of the Administration Building. The General Electric Company also makes, in connection with its marine exhibit, a very extensive display of the search light projector, showing the various types that they make of focusing lamps and projectors.

It will thus be seen that this exhibit is by far the most extensive and most interesting at the Exposition. It is one which redounds to the credit of the great company which made it, and to the American energy, ability and talent of which it is the crystalization.

Digitized by Google

APPENDIX T.

Digitized by Google

Digitized by Google

GENERAL ELECTRIC COMPANY

PRESS OF BARTLETT & COMPANY NEW YORK

Digitized by Google

AWARDS FOR COMPLETE SYSTEMS OF ELECTRIC INCANDESCENT AND ARC LIGHTING. ELECTRIC RAILWAYS AND ELECTRICAL APPARATUS.

Paris, 1882. Diploma of Honor. This was the most distinguished honor that the "International Congress of Electricians" could confer, bestowed as an award of greater distinction than the Gold Medal Three additional Diplomas of Honor, two Gold Medals, and a Silver Medal, Officer of the Legion of Honor.

London, 1882. International Electric Exhibition. The only Gold Medal for complete System of Incandescent Electric Lighting.

Cinn., O., 1883. Prize of Five Hundred Dollars, Gold Medal and First Prize for the Incandescent Lamp.

London, 1885. International Inventions Exhibition. Gold Medal.

Edinburgh, 1886. International Exhibition. Gold Medal.

Paris, 1886. Diploma of Honor—highest award.

Melbourne, Aus., 1888. Great International Exhibition. Gold Medal.

Brussels, 1888. Diploma of Honor—highest award.

Paris, 1889. Great International Exhibition. Grand Prize, Gold Medal and Bronze Medal.

Bremen, Germany, 1890. Gold Medal.

Paris, 1890. Grand Prize awarded for most perfect Recording Electrical Meter.

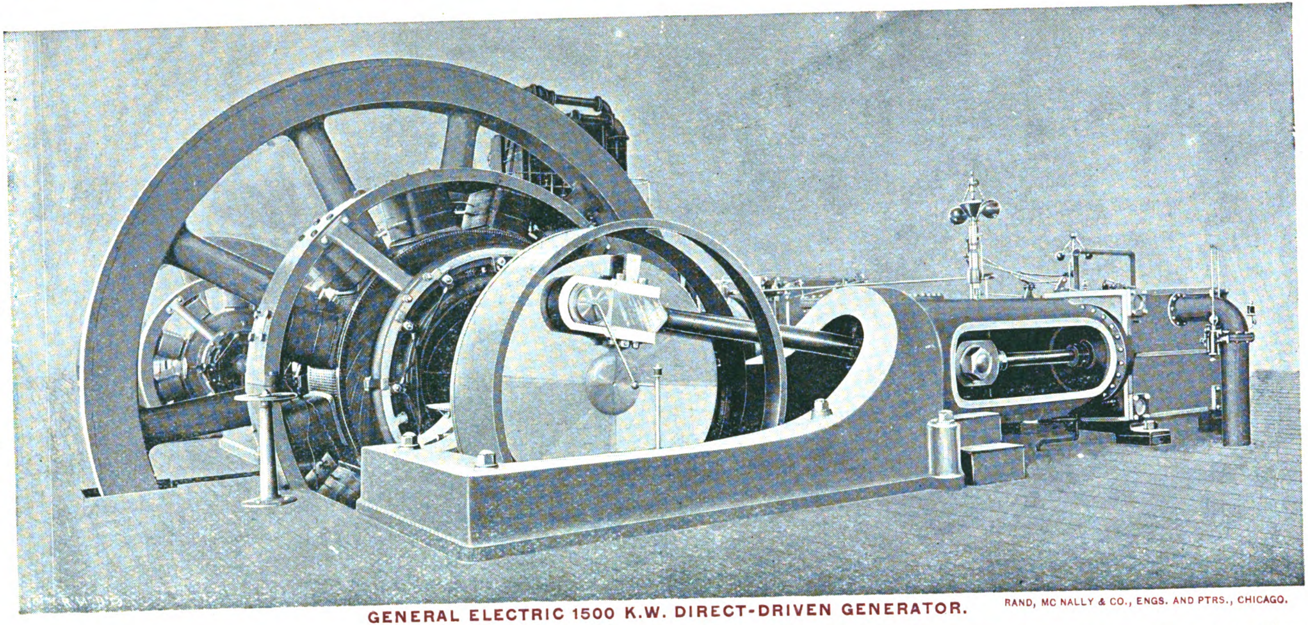
Cherson, Russia, 1890. Silver Medal.

Frankfort, 1891. Diploma of Honor.

San Francisco, 1891. Four Gold Medals.

London, 1892. International Electrical Exhibition. Gold and Silver Medals.

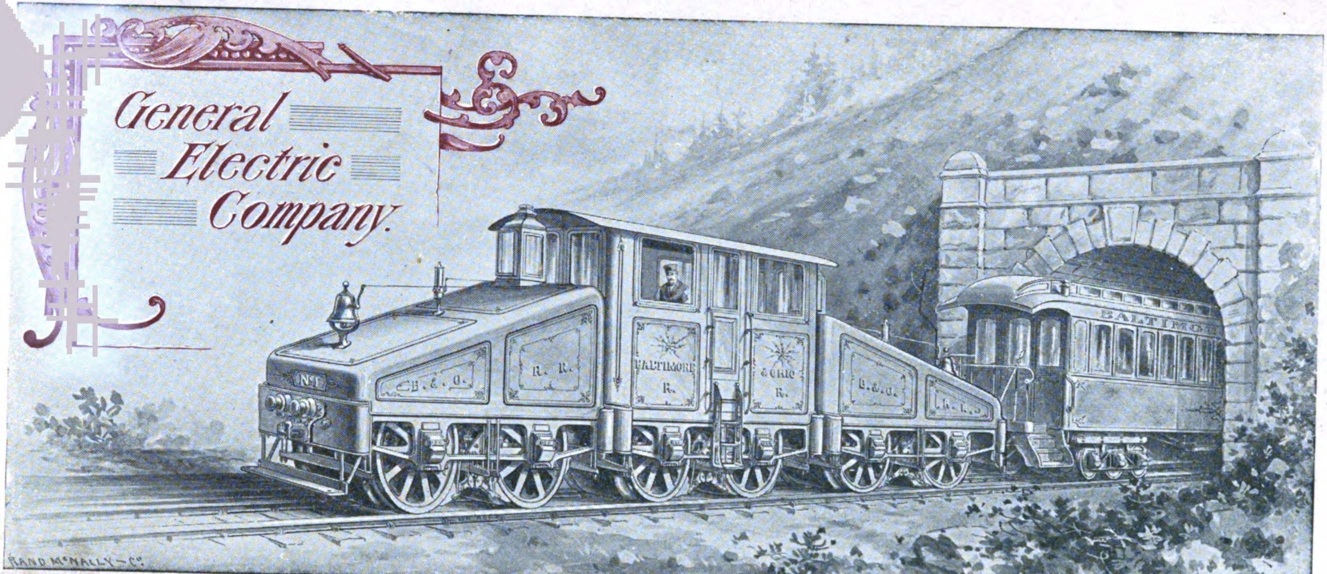
Digitized by Google



GENERAL ELECTRIC 1500 K.W. DIRECT-DRIVEN GENERATOR.

RAND, MC NALLY & CO., ENGS. AND PTRS., CHICAGO.

Digitized by Google



GENERAL ELECTRIC CO.'S ELECTRIC LOCOMOTIVE FOR B. & O. TUNNEL.

Digitized by Google

Digitized by Google

Date Due

ILL MAY 22 '74 CANCELLED			

DEMCO NO. 38-298

Digitized by Google

TK
Form 3251
1
A8 374597
v.9 Association of
Illuminating

TK 374597
1
A8
V.9

LORD HALL LIBRARY

Digitized by Google

The Ohio State University
3 2435 05436434 4
THE OHIO STATE UNIVERSITY BOOK DEPOSITORY
D 8 AISLE 03 SECT 35 SHLF 22 SIDE 8 POS 07 ITEM 006 C 9
Digitized by Google